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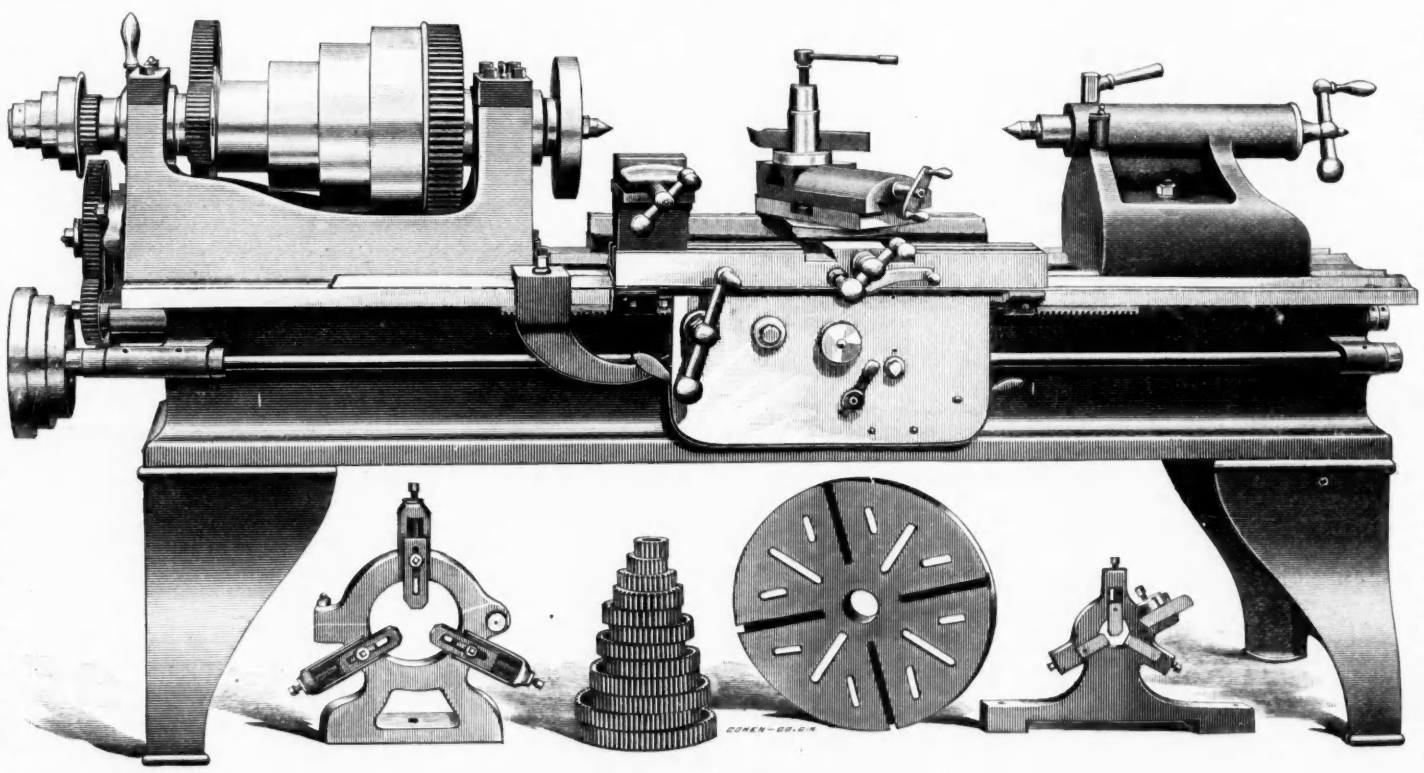
ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

New Engine Lathe.

The manufacture of the line of lathes of which the engraving is intended to represent the 19 and 21 inch swing, originated in the filling of a special order for a tool possessing some desirable features not possessed by the lathes regularly built. These features proved so desirable that the regular manufacture of such lathes was begun. They are made with special conveniences for quick and easy handling, and of the best material.

Good provisions for taking up wear are provided, and for easy and constant lubrication. Boxes are fitted so as to present a full circle their entire length, care being taken that the solidity of the lathe does not depend on the tight fitting or adjusting of screws. The spindle is hollow, the 19 inch swing having $1\frac{1}{2}$ inch hole clear through, and the 21 inch swing having $1\frac{7}{8}$ inch hole.

The lathes cut threads 2 to 18 per inch, with only one change on spindle, the balance of changes being made on screw. The gearing has extra width of face, the pinion engaging with face wheel being of steel. The large and small face plates have T slots across the face.



NEW ENGINE LATHE.

The live heads are webbed their entire length and not cut for reverse plates; all feeds are reversed in the apron. Nuts and clamping bolts are steel.

The carriages have long bearings provided with lubricating devices to prevent cutting. The compound rest has bearing on cross slide of carriage of 18 inches. The taper attachment is capable of turning or boring a taper of 6 inches to 1 foot.

The lead screws are steel placed directly under front V on which tail stock slides and inside of bed are covered, and take hold of the carriage in the center of its weight and directly under the line of strain when cutting screws.

The half nuts, operated by a new device, are made from solid metal (not babbited) and have planed bearings 8 inches long. The dog shown on bed may be set and clamped at any point, and will then form an automatic stop for carriage; this is a convenient feature where large quantities of work of one kind are being done, besides making it very handy to drop rack pinion out if desired when cutting screws. All feeds will reverse instantly without losing a fraction of a revolution.

The rest to turn full swing is furnished with every lathe. It will be noticed the following rest is provided with means of adjustment, so that any size of shaft within its range may be readily handled.

Countershaft is furnished with this lathe with either tight and loose or friction pulleys for 4 inch belt, and should run 120 revolutions per minute. Everything shown on cut and described above is furnished with each lathe.

The 19 inch lathe swings $19\frac{3}{8}$ over ways, and 11 inches over carriage; the 21 inch swings $21\frac{3}{8}$ inches over ways and $13\frac{1}{4}$ inches over carriage.

The manufacturers are Lodge, Davis & Co., Cincinnati, Ohio.

Some Notes on Steel.

BY JOHN COFFIN.

In my last article there was an omission of the decimal points—very likely due to my carelessness—which I would like to correct.

The carbon of the bars I experimented on was respectively .90, .17 and .07 per cent.

I will not attempt to define steel, but hereafter when I say steel I mean the ordinary carbon steel of commerce. Carbon occurs in steel in three forms, graphitic, non-hardening and hardening. I prefer to use these terms because they do not conflict with any one. The graphitic carbon is the principle form of carbon in cast iron and will not dissolve in nitric acid. Non-hardening carbon is the principal form of carbon in annealed steel. It will not dissolve in cold nitric acid, but will in boiling. Hardening carbon is the principal form of carbon in hardened steel, and will dissolve in cold nitric acid.

As there is very little of the first form of carbon in steel, I will leave it out of consideration for the present. If steel is heated to a certain temperature, which I will call for convenience the hardening temperature, its carbon nearly all changes to hardening carbon. If it is now slowly cooled its carbon changes slowly to non-hardening carbon; this change commencing at a temperature somewhat below the hardening temperature.

If the steel be cooled quickly by immersing in water, or otherwise, the carbon has not time to change to non-hardening form, and the result is cold steel containing hardening carbon or hardened steel. The experiments going to prove this are as follows:

If a bar of steel be heated and cooled in water at successively increasing temperature, it will not harden until a certain temperature is reached; or if you heat one end of a bar of steel to the hardening temperature, and let the heat grade down through 5 or 6 inches of the bar and attain this gradation of heat by continually heating and at no time cooling in the fire, and then cool suddenly in water, you will not have a grade of hardness, but there will be an easily distinguished boundary between the hard and soft part.

Having determined the hardening temperature, if the bar be heated to this temperature it may be allowed to slowly cool somewhat before putting it in water, and it will still be hard; or if you heat a short bar, say 6" long, uniformly in the fire until it comes to the hardening temperature, and then remove one end and allow it to cool somewhat, and then suddenly cool the whole bar in water, there will be no apparent difference in the hardness of the two ends. There are some things which slightly modify the results of these experiments, but the conclusions are that non-hardening carbon changes to hardening carbon at a certain temperature while heating, and it begins to change to non-hardening carbon while cooling at a somewhat lower temperature. Brinnell calls this property the chemical inertia of carbon. At the temperature at which the carbon begins to change to non-hardening carbon while cooling, the change of the greater part of the carbon is comparatively rapid, yet the most complete change is attained by very slow cooling.

The changes of carbon both in heating and in cooling present some remarkable phenomena, one of which I recounted in my last article, namely, a re-heating of the steel while changing to the non-hardening form; another and more important result of change is manifest while heating the steel and while the carbon is changing to hardening form. The tendency of this change is to break up and destroy crystallization and make the steel fine and close.

If a bar of tool steel is heated evenly to exactly the correct hardening temperature and cooled very suddenly in water, it will be found by breaking to be very fine indeed.

This is what an American writer styles "refining by tempering." The refining is indirectly due to sudden cooling. That is, the refining took place while heating and while the carbon was changing, and the sudden cooling prevented a re-crystallization as crystals take time to form.

The proof is, if we take a piece of very coarse crystalline steel and heat it to the hardening temperature and then let it slowly cool, the result will be that it is very much refined, and only has small crystals due to the slow cooling from the hardening temperature; and furthermore, the slower steel is cooled the larger the crystals and the less cohesion they have between their faces. Sir Henry Bessemer by very slowly cooling molten steel succeeded in obtaining crystals as large as playing dice, with so little cohesion between their faces that they could be readily broken apart with a tack hammer, yet each crystal in itself was perfectly amorphous and very ductile, and could be flattened out under a steam hammer into a very thin wafer with only slight cracks at their edges.

In experimenting with heated steel I made the following very curious discovery. During the time while the carbon is changing, either in heating or cooling, the steel is very weak, and is easily bent or distorted, and it seems in perfect harmony with our theory of molecular motion that at this time this should be so; but as it is the object of these articles to give some practical information on the treatment and use of steel in the shop, I will not enlarge on the theory, but give the details of some experiments, and let you draw your own conclusions.

I took a bar of Bessemer steel, $\frac{5}{8}$" square, by 4 feet long, .20 per cent. carbon, and placed it on the level floor of a heating furnace, and slowly raised its heat to a bright

yellow. I then raised it without taking from the furnace, and placed a brick under each end, leaving the middle unsupported, and carefully watched the deflection. At the end of five minutes it had deflected $\frac{1}{2}''$. I then turned it over, and at the end of eight minutes it had come back straight. I then moved it, with its supports, to a cooler part of the furnace, and turned it back and forth to keep it straight until it had cooled down to an orange color, when I again observed the time, and let it rest. At the end of half an hour I could not see that it had deflected any.

I then took it from the furnace, and placed it on prearranged supports at its ends. Care was taken to have it cool evenly. It was protected from drafts of air, and far enough removed from surrounding bodies not to be influenced by them.

It remained perfectly straight until the temperature was reached at which the carbon began to change to non-hardening carbon, when it began to deflect rapidly, and at the end of about one minute's time the middle had sagged down $2\frac{3}{4}''$ from its former position; and when the bar was cold, the middle measured $2\frac{3}{4}''$ from the straight line joining the ends. What a wonderful phenomenon this is: A steel bar bent by its own weight at a very low red-heat $2\frac{3}{4}''$ during one minute of time, although it had supported itself for half an hour at a very much higher heat.

Connecting this phenomena with the change of carbon, though I had not at that time conclusively established it, I resolved to see if a corresponding weakness occurred while the carbon was changing from non-hardening carbon to hardening carbon.

To determine this, I straightened the bar, and placed it while cold on the supports in the furnace, and carefully observed it while heating. It passed the temperature without deflecting at which it deflected while cooling, but when a somewhat higher temperature was reached it went down very rapidly, yet this temperature was less than that at which it had supported itself in the furnace while no change of carbon was going on.

The fact that the deflection occurred at a higher temperature in heating than in cooling served to strengthen my opinion that the weakness was due to the change of carbon, and not peculiar to any temperature, for we have seen before that carbon changed to hardening carbon while heating at a higher temperature than to non-hardening carbon while cooling.

I repeated these experiments a number of times, and on steel ranging up to one per cent. carbon. I have observed that the re-expansion spoken of in my last article commences at the temperature at which the cooling bar begins to deflect, and have made other observations which confirm my belief that this weakness is directly due to the change of carbon.

It seems to me that this opens a new and fertile field for the investigator. With this sure index of the change of carbon, with good means for measuring and comparing temperatures, and with time, money and patience, a series of experiments might be tried that would be of great value to the world.

Pattern Making.

By F. W. Barrows.

ONE WAY OF MAKING A CROSSHEAD.

I was going to tell where the pattern shown in the figures was made; but I will leave that out and only say that I was given the pattern to make from a blue print of the finished piece, and was given all instructions necessary as to finish, core prints, etc., and was also told that it was to be made in a three-part flask.

Although there had been other sizes of the same piece made, which I had seen in a general sort of a way, I couldn't for the life of me tell how it should be made for a three-part flask; but I could see very plainly how it could be moulded in a two-part flask, and after some further talk it was agreed that it should be so made.

It was required to mould the flanges a b down, to keep them as free from dirt as possible. The center pin was to have a hole cast through it, for oiling, I believe. The piston-rod socket was to be cored through, as shown by d in Figs. 83 and 84.

Fig. 82 is a section through lines j k; 83 is a section through g h, 84 a section through e f, while 88 is a section on lines passing through its center. The letters refer to similar parts in all the figures. Outlines of core-prints and partings are designated by dotted lines.

Get out the two flanges a b to the width shown in Fig. 82 at i, and across one end—the end toward cylinder; fit a piece having a width equal to the distance from l m to n, Fig. 84, and thick enough to reach from the lower side of flanges up to the center line e f. This piece should be long enough to reach across the flanges, and should be cut into them half their thickness. The side of this piece towards center pin is then to be cut away, as shown by dotted lines between d and n in Figs. 83 and 84.

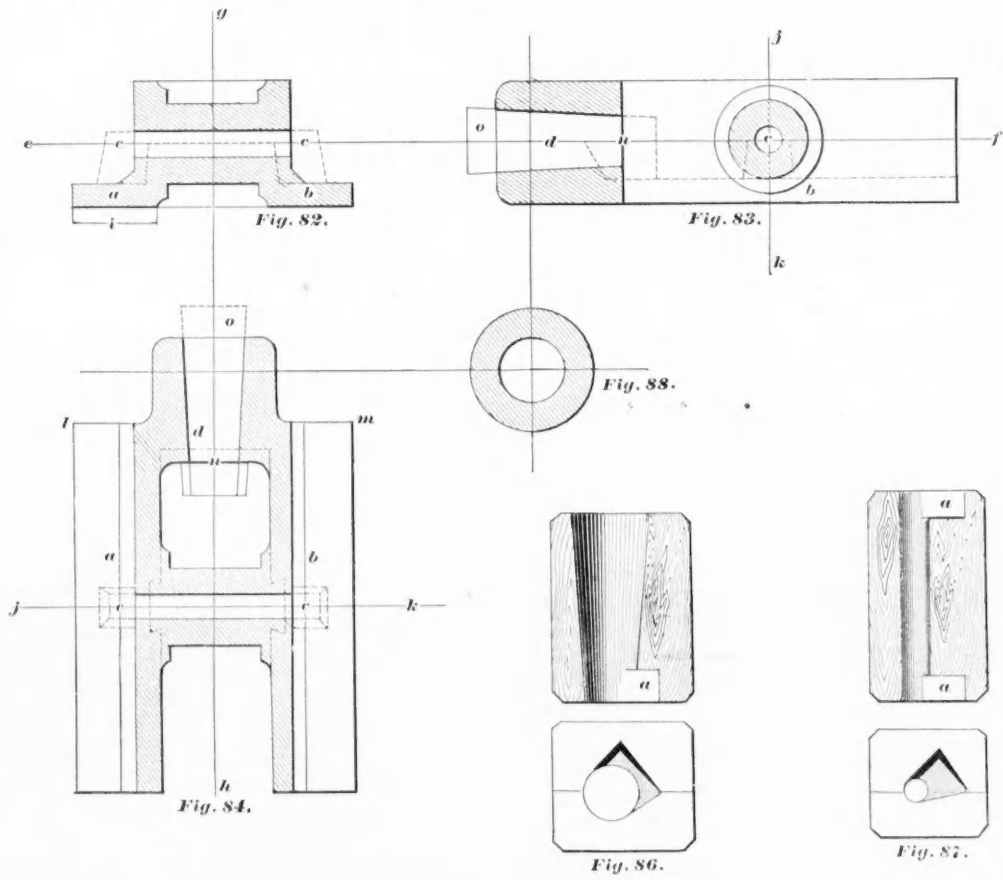
The sides of the crosshead are then gotten out and fastened together by that part of the piston rod end of pattern which is inside the ends of flanges at l m, Fig. 84. This piece must be fitted into the recess cut in lower half at n. The sides must be placed a little further apart at the top than the bottom, to make the pattern draw nicely. Don't make too much draft as it will make trouble for the moulder in cutting down to center of pin, and also make the casting look bad. The outside of side pieces may be nearly square. Now get out some fillets as are shown above a and b, Fig. 82. They should be made of hardwood in order to preserve the edge which meets the flange, and is liable to be broken off, as the parting is made between the fillet and the flange. The fillet is made in the shape shown for the same reason.

Then the center pin c is turned up as a split pattern, the facing pieces, which also form the shoulders at each end of pin, to be made separately, and in halves. Their thickness must be such as to allow for the draft on side pieces. Here is something that it will pay to remember: If we make the draft on these shoulders, from the pin to their circumference, equal to the draft on side from center line e f to the top, then, after these pieces are fastened to sides they may be planed off square with the center of pin, without destroying the draft, and thus making it easy to cut in the center pin, and it makes a neat job. The dovetails shown each end of center pin should be cut through to the bottom of flange and well fastened to the flange as they are all that keeps the lower half of pin, to which they are also fastened, in place.

That portion of the rod end of pattern, which projects beyond the ends of flanges, may now be turned up and fastened in place, making it in two pieces, parted through the center. This pattern needs no dowel pins and is now ready for the core prints. The one marked o may be made with the end of the crosshead, the one at n should run down to the parting at top of flanges or wings. The prints at each end of center pin should also run down to the flanges.

This looks like a crooked piece of work, but in reality it is very easy to make, and the moulders were very much pleased with it, and consequently the casting looked slick and clean, in fact, all the sizes which had previously been made for three part flasks, were sent for and changed to mould in the way I have shown.

There are two core boxes to make for this job. Fig. 86 is the box for piston-rod socket, and is tapered as shown, with a recess at one end—the smallest end that the core may fill up the print in mould. Fig. 87 is the box for center pin. This box has a recess at both ends to fill up the mould. Don't forget to leave a corner at a in both ends of box, corresponding to a section of the fillet between sides and flanges, thus making the core so that it will leave intact the fillet between sides and flanges on casting.



Early Engineering Reminiscences.

By George Escol Sellers.

TWENTY-NINTH PAPER.

If I am not greatly mistaken at the period of our visit to Mr. Gilpin's mill, he was the sole manufacturer of endless or machine made paper in America, and it was from perfecting the simple cylinder that I have described as the work of a Frenchman in New Jersey, and its appliances, that the rapid introduction of machine made paper in America takes its date.

I am strongly impressed with the belief that when John Ames, of Springfield, Mass., got up his squirrel-wheel cylinder and machine, and patented it, that he had no knowledge of what had preceded him in New Jersey, although they were substantially the same. My father greatly improved this simple cylinder, by substituting for the longitudinal round rods, drawn rods, of an oval or rather egg-shape, somewhat like the wooden bars of the paper mould, only being made of brass, much smaller. These, besides being secured in drilled holes in the rims of the end wheels of the cylinder, were sunk half their depth into sharp-edged rims of the supporting wheels, to which they were firmly secured, instead of simply resting on round rims secured in position by looped wire sewing, as in the case of the New Jersey cylinder. To secure the wrapping wire of No. 18 hard-drawn brass, forming the foundation or under face (without sewing) notches of one-half the diameter of the No. 18 wire, were cut spirally around the cylinder in the outer edges of the oval longitudinal bars, leaving a space of $\frac{1}{4}''$ between each turn. This was done by a traversing buzz cutter that spirally notched the bars as the cylinder revolved. The No. 18 wire, being wound in these notches, was held firmly in place by a wove wire backing of about fourteen meshes to the inch, on which the outer face of the cylinder was placed, the only sewing being that to secure the ends of the faces where they met together.

This simple cylinder produced the effect apprehended by Mr. Gilpin; its comparatively small cost, compared with his elaborately constructed cylinder, put it within the reach of all paper makers, no matter how small their mills. Many single vat mill owners were among the first to adopt it.

The putting up and starting paper machines became a leading business for a number of millwrights. The proprietor of the mill would procure a cylinder complete, with the shafting, gearing and spindles for the wooden press rolls, all of which we furnished in sets. Beyond this, all was the work of the millwright. Old apple orchards furnished the material for the press rolls; even the housings they ran in were at that time made of wood. I do not recollect finished cast-iron housings, with boxes complete, being called for earlier than 1829, about which time we began to keep them on hand to fill orders.

The cost to the paper maker of a complete cylinder, 2 feet diameter by 3 feet long, was $160, with a charge of $3 for every additional inch in length. A few cylinders, as much as 30″ diameter, were made, mostly for making inferior grades of wrapping paper out of stock lacking in felting property requiring more difference between the dilute pulp outside and the water inside of the cylinder, such as straw digested with quick-lime, discovered and introduced about that time by Geo. Shryock, of York, Pa. The cost of putting and starting a simple squirrel-cage cylinder machine with wooden press-rolls, was from $500 to $600. From about the year 1830 we had a number of millwrights constantly out and emplyoyed on this kind of work, it being about that period that the rapid change from hand made to machine made paper had fairly set in. I give the above figures entirely from recollection. When my brother and myself left Philadelphia in 1840, the old account and order books were stored there; but since the death of the person they were left with I have lost all trace of them, which I regret, as from them reliable and actual dates of all the advances made in paper making machinery, from Gilpin's machine and the New Jersey cylinder of the Frenchman, up to the close of 1839, could have been obtained.

From the best of my recollection, Messrs. Phelps & Spafford were the first builders in the United States of the long-web Fourdrinier machine, with steam driers complete, their machine being a close copy of Bryan Donkin's About the same period cylinder machines with driers were being built at Brattleborough, Vt., and other places, our works at that time being confined exclusively to cylinder machines without driers, which we did not commence building until 1833.

The rapid change from hand to machin

made paper, when the start had fairly been made, created so great a demand that many establishments went into the manufacturing of both cylinder and Fourdrinier machines, the names of many of which I cannot recall. Nelson Gavatt, who had been employed in setting up and starting machines for Phelps & Spafford, established works in Philadelphia. At a later period Barton, Rice & Co. and I. L. Severs, of Worcester, Mass.; Smith & Winchester, of South Windham; Merrill & Co., Beloit, are among the names that at present occur to me who built paper machinery.

About the years 1831 and 1832 there was much discussion as to the merits of copper or cast iron for drying-cylinders. The thin copper transmitting the heat rapidly, it was urged that the same regularity could not be kept as when the thicker and less rapid conductor, cast-iron, was used. It was reported that John Dickenson, for his fine qualities of copper plate veneered paper, used cast-iron drying cylinders, and that Bryan Donkin was covering cast-iron drying cylinders with sheet copper that was so perfectly and beautifully done as to excite the admiration of everyone. They bore the appearance of having finished by turning with great accuracy a very difficult job with copper as thin as used when not soldered or cemented to the cast iron. Letters from England spoke in such high terms of these improved dryers that several prominent paper makers were contemplating importing machines from Donkin.

When discussing the advisability of going to England to investigate the entire subject and learn if possible the advantages, if any, over the American machines, Philadelphia was stricken for the first time by the Asiatic cholera. Having no fear of the disease, I became active in cholera hospital arrangements, and in attending at them. The result was an acute attack, and I was so utterly prostrated by it that for recuperation a sea voyage was decided on, and the trip to England was hastened. It being before the day of ocean steamers, three or four weeks on a sailing packet was deemed sufficient. I arranged to spend at least four months in England giving ample time to see and learn all that was accessible in the way of civil and mechanical engineering. We had learned through Jacob Perkins and my friend Joseph Saxton, both then in London, that access to many mechanical works was difficult, and, in some cases, impossible for Americans; that Bryan Donkin's works that above all others I desired to see, was absolutely closed against all foreigners. Both Mr. Perkins and Saxton had frequently met Mr. Donkin in a social way, but had never been invited to visit his works In fact, Mr. Saxton had made application without success. My prospect in that direction looked dull. My uncle, Rembrandt Peale, the artist, on his return from Italy had spent some time in England, and by invitation visited Sir Walter Scott, at Abbotsford. He said that while there Sir Walter referred to Bryan Donkin in the warmest terms of friendship, and offered Mr. Peale an introduction to the man whom he esteemed as a model man for application, energy and sterling honesty. My uncle, in offering me a letter to Sir Walter, suggested that through him I might get a favorable introduction to Mr. Donkin Although there was no man in England out of my own line of business that it would have afforded me mere pleasure to meet than Sir Walter, I declined, feeling a delicacy of intruding as a mere curiosity hunter. I refer to this to relate a little incident that occurred on the outward voyage. About mid-ocean we met a west-bound vessel. Our captain slightly altered his course to come within hailing distance, the answer to which came: "Bark ——, lumberman, of St. John's, New Brunswick; from London; homeward bound." This was at a time of great political excitement in England—in English phraseology, a crisis. Wellington had been invited to re-form a cabinet; in answer to the hail of "What political news?" came "Sir Walter Scott is dead;" to the question of "Any other news?" as the distance increased between the vessels, all we could catch of the reply was the reiterated, "Sir Walter Scott is dead." No possible calamity short of total shipwreck could be greater to the skipper of the lumbering lumber bark than the loss of the author whose writing had cheered the hours of his long and tedious voyages. It was a heart felt tribute to Sir Walter Scott.

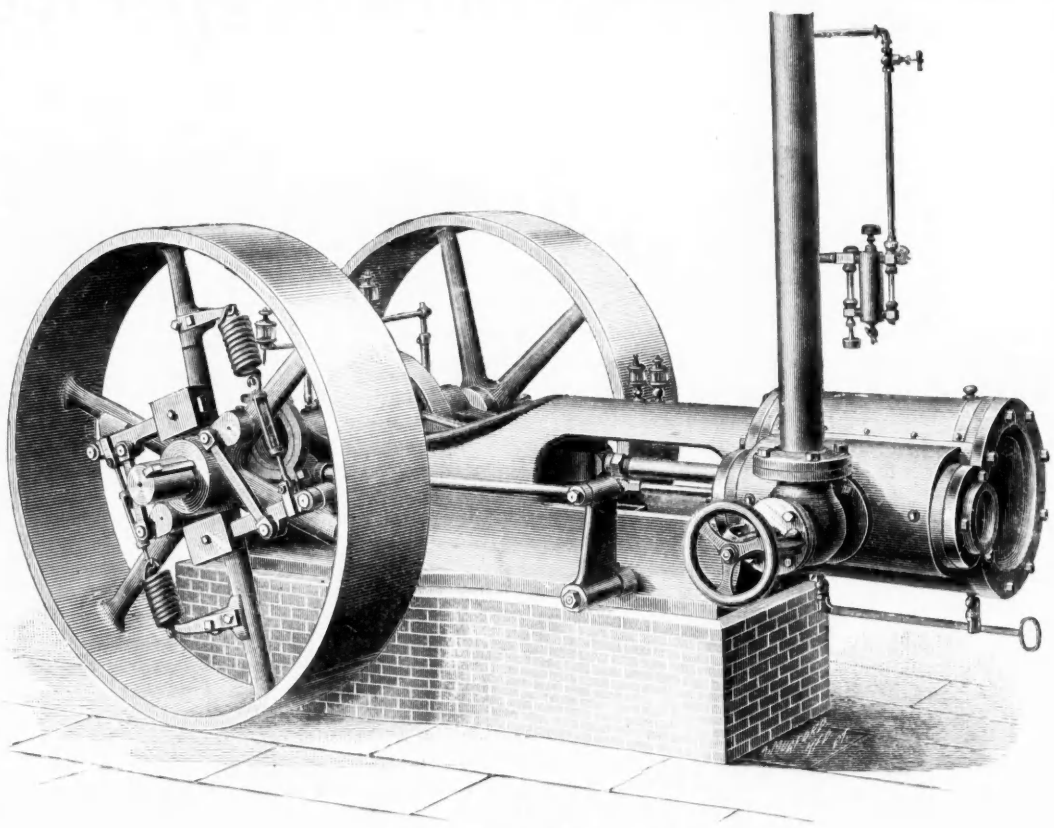
I spent considerable time previous to going to London in visiting mines, iron and general mechanical works in the vicinity of Manchester, Birmingham, Sheffield and Halifax. At one establishment I found them casting of iron, washing and beating engines the entire cistern in a single piece. There were no recesses or any provision for sand traps. This inclines me to believe that this important attendant to all good beating or washing engines is of American origin where they were in common use from my earliest recollection, and these unalterable cast-iron engines were the first I had ever seen where they were omitted.

During these excursions, which were made under the most favorable circumstances as to introductions, I had the opportunity of seeing several of Donkin's Fourdrinier machines in operation, and from the owners of two of the mills using them received letters of introduction to Mr. Donkin, in both cases without solicitation on my part.

On my way from Birmingham to London I stopped at Oxford, mainly to see the great printing establishments, said at that time to be the finest in the world. To Oxford I was accompanied by a friend from Birmingham, who introduced me to Mr. James Swann, of Ensham, a very courteous gentleman who had two expensive paper mills both equipped with Donkin's newest and most improved machines. He took us to his place where we remained a couple of days visiting with him both of his mills, giving opportunity of learning all then known as to paper making machinery. The beauty of these machines, and great perfection in performing their work, made me more desirous than ever to become favorably acquainted with Mr. Donkin. It was at these mills that I first saw the Ibbotson pulp dresser, built by Donkin, in use. It only differed from the slit plate pulp dresser in use in the United States in being made of separate bars, the spaces between which were regulated by slips of sheet brass of a thickness to give the space required between the bars. My father had invented and patented in the United States a pulp dresser that we had successfully applied between the stuff chest and vat of the hand-making paper mills. I took one of these to to England with me, thinking it might be worth securing there by patent; at all events it would be useful as a favorable introduction in obtaining the information I was in search of. I sketched for and explained this device to Mr. Swann, who advised my sending the machine to Mr. Donkin, and advising with him. He asked me if I was aware that simply exhibiting the machine would, in case of litigation, be fatal to a patent either issued to the inventor or introducer. On replying that I was fully informed on that subject, he said I would be perfectly safe in consulting Mr. Donkin in confidence. He then asked if I had any friends in London who could favorably introduce me. I replied no, unless it were John J. Hawkins or Mr. Jacob Perkins, or Charles Leslie the artist. He said Mr. Perkins would not do, for he knew Mr. Donkin was jealous of, and prejudiced against, Americans, and he had reason to think of Mr. Perkins in particular. As to Mr. Hawkins no one could be better, but Hawkins was aged and somewhat infirm, and might not be able to go with me to the works. As to Leslie, he had never heard Mr. Donkin speak of him as an acquaintance, though no doubt he knew him by reputation. I said that I already had two letters of introduction from parties owning and using Fourdrinier machines made by him. If open letters of introduction there would be no impropriety in his asking to see them. When I placed them in his hand he glanced at the signatures and shook his head, saying that my having received the letters I was bound by etiquette to deliver them, but he did not think they would gain my object. He went to his desk and wrote to Mr. Donkin, placed it in my hands, and asked if it met my views. He simply told Mr. Donkin, by whom I was introduced to him, that I was engaged in America in the same line of business that he was; that he believed a free interchange of ideas would be mutually beneficial; that he could assure him that I would not intrude or be inquisitive into any matters that he was not disposed to communicate. He then advised my going to Mr. Donkin without any one with me, and in handing him the letters to be careful so to place them, that he would be likely to look at the others before opening his; he told me of many of the little peculiarities of Mr. Donkin, and told me to observe him closely as he read the letters.

On my arrival in London I found Mr. Jacob Perkins very busy at the Adelaide Gallery, where he was exhibiting his high-pressure steam generators and his model marine engine, his steam gun, water compressor, cutting off steel bars or old files by a rapidly-revolving wrought-iron disk, in a large tank fifty or more feet in length, in the center of the hall floor; his steamboat propelling apparatus, consisting of paddle wheels set at an angle of 45° to the keel, on shafts, instead of running across the boat, diverged from a point towards the stern, where they were geared together by bevel wheels. In this position the paddle floats entered the water edgeways, and came out in the same manner, and in the lowest rotation and deepest dip of the wheel were at right angles with the keel, producing an action similar to the Chinese method of sculling, but by rotary motion instead of reciprocating, causing very little disturbance of the water. There was always a crowd interested in watching the races between the little boat with diagonal paddle and a precisely similarly-constructed hull, with the ordinary paddle wheels, both driven by clockwork said to be of equal power. Joseph Saxton was at that time assisting Mr. Perkins, and, as an attraction to the gallery, he had constructed a little railway its entire length, on which he ran a light lightning package express, the propelling power being applied by cord on differential wheels with draft close to the tread. I do not think Mr. Saxton ever had the idea of applying this practically, but merely as an attractive feature to the exhibition; it certainly caused much amusement to take hold of the cord, and by a short draft hurl the little car from end to end of the long gallery. Saxton also had on exhibition an electric magnetic motor of his own invention and construction in which great velocity was obtained; the power being from battery, as in Pages' engine, that at that time was exciting much attention in America.

Between what Mr. Perkins had to show me, the introductions tendered, in fact insisted on, the various places of interest I visited with him, Mr. Saxton and grandfather Peale's old associate and friend, John Isaac Hawkins, several days slipped by before I had the opportunity of seeing the then great works of Brandsley, or delivering my letters to Mr. Bryan Donkin. As this paper has run to so great a length, what I then saw and learned in the way of mechanical engineering must be deferred to my next.



SINGLE VALVE AUTOMATIC ENGINE.

A New Single Valve Automatic Engine.

The illustration which we herewith present is of an automatic engine recently brought out by the Morris Machine Works, of Baldwinsville, N. Y., which is designed for electric lighting purposes. These engines are built from entirely new patterns, with the latest improvements. Special attention has been paid to making all parts plain, simple, strong and durable. All wearing surfaces are large. The material throughout is the best, and they are well made, with the latest improved machinery, thereby securing accuracy and durability.

The engines as now made are self-contained, having only two shaft bearings. The shafts are large, and bearings long, giving both large area of bearings and strength in excess of any reasonable duty. The valve is of the piston type, cast hollow, as light as is consistent with strength, and is fitted with spring rings which travel in removable bushes, which can be replaced should occasion require without taking cylinder from frame. The piston is light, and is fitted with self-adjusting packing. The cylinder is made from a close-grained iron, and great care is taken that it should be free from sand-holes or other imperfections. It is very important that it should be strong and heavy, and the manufacturers appear to have spared no metal, and to have used good judgment in its distribution. The ports are large, short and direct, and are of sufficient proportion to admit of high piston speed. The shaft is of the best hammered iron, forged solid and then slotted. Disks are placed on same and held in place by set screws to aid in counterbalancing. All working parts are of steel and phosphor-bronze. The automatic governor is the "Tabor," simple in construction, all parts being in sight and easily accessible for cleaning The variation in speed from no load to full power of engine is said to be less than two per cent.

Messrs. Cooke & Co., of 22 Cortlandt street, New York, are the representatives in this city of the Morris Machine Works, and have a sample engine in store.

Modern Locomotive Construction.

By J. G. A. Meyer.

Thirty-Second Paper.

CLASSIFICATION OF LINKS.

When links are classified with reference to the manner of their suspension, we have, according to the twenty-seventh paper, the shifting link and the stationary link.

When these same links are classified with reference to their form we have the following two classes, namely, the box link as shown in Fig. 172, and the open link as shown in Figs. 173 and 175. In American locomotives the former is seldom employed, the open link being the favorite; and, therefore, we will consider the latter only.

The open link can again be divided into two classes, namely, the solid link, as shown in Fig. 173, and the built up link, generally called the skeleton link, shown in Fig. 175. The term "skeleton link" we shall hereafter adopt for this class of links.

DEFINITIONS.

Fig. 173. Link arc is an arc as *a b c*, drawn through the center of the opening.

Length of link is the length of the opening measured on a straight line joining the ends *a* and *c* of the arc *a b c*.

Radius of link is the radius with which the link arc *a b c* has been described.

Eccentric rod-pin arc is an arc as *e d* drawn through the centers of the eccentric rod pin-holes *F F;* this arc is described from the same center as that used in describing the link arc *a b c*.

The manner of suspending the link and attaching the same to the rocker is plainly shown in Fig. 174. *R* is the lower rocker arm; *A* the link block pin; *B* the link block; *L* the link; *S* the link saddle; *P* the link saddle pin; *H* the link hanger; *C* the end of the lifting shaft arm, and *D* the lifting shafting pin.

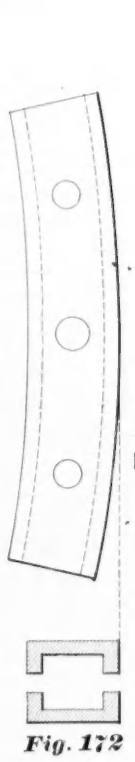


Fig. 172.

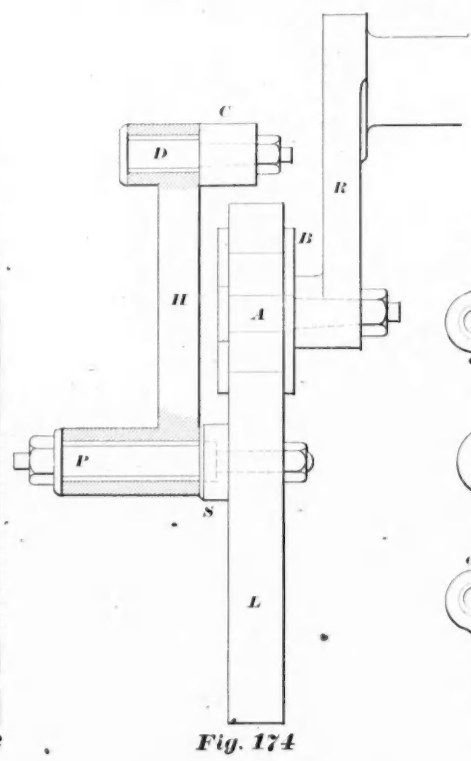


Fig. 174.

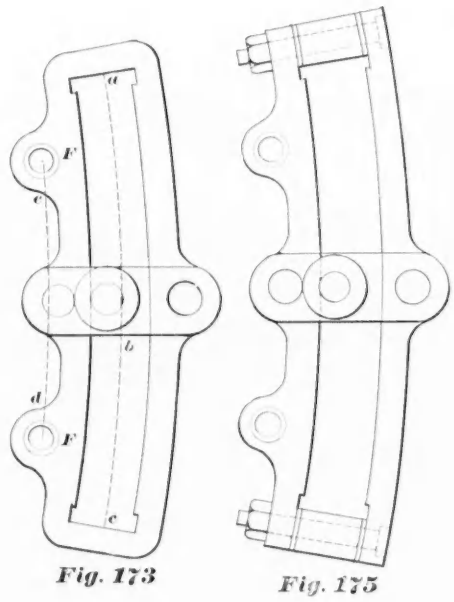


Fig. 173.

Fig. 175.

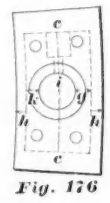


Fig. 176.

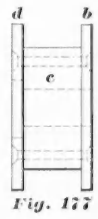


Fig. 177.

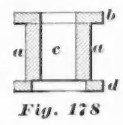


Fig. 178.

Fig. 179.

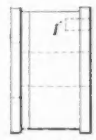


Fig. 180.

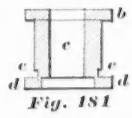


Fig. 181.

LINK BLOCKS.

The link block is made of wrought iron and case hardened; it works freely and accurately on the pin *A*. For skeleton links, the link block is generally made in one piece, the grooves *a a*, Fig. 178, being turned out of a solid piece of iron. But when the solid link is used the link block consists of two or three pieces. Fig. 176 represents a side view; Fig. 177 an end view; and Fig. 178 a section of a link block which is made in three pieces, namely, the plates *b* and *d*, and the block *c;* after the block *c* has been placed in the opening of the link the plates *b* and *d* and the block *c* are riveted together by four $\frac{3}{8}$" rivets when link block is large, and four $\frac{1}{4}$" rivets when the link block is small; the position of the rivets is shown in Fig 176.

The advantage claimed for a link block made in this manner is, that the curved surfaces *a a* of the block *c* and the plates *b* and *d* can be finished in a slotting machine, which in some shops is more convenient than turning the curved surfaces of the block. Some master mechanics prefer to make the link block in two pieces, as shown in Figs. 179, 180 and 181. Link blocks made in this manner consist of the plate *b* and the block *c* with the projections or flanges *d d* forged on to it. Close to the flanges *d d* small grooves *e e* about $\frac{1}{16}$ of an inch deep and $\frac{3}{32}$ of an inch wide are turned into the curved surfaces; with these grooves the surfaces can be finished completely with an emery wheel without using special tools for finishing the corners after the link block has been case-hardened. Sometimes the plate *b* is riveted to the block as shown in Fig. 176, and at other times the plate *b* (Fig. 180) is not fastened to the block *c* in any manner. In this case the plate *b*, when the link block is in position must be next to rocker arm, and is prevented from turning around by a $\frac{3}{8}$ inch pin *f* as shown in Fig. 179, 180; the block and plate being held together by the link block pin. All link blocks, no matter whether they are made in one piece or several pieces, are counterbored as shown in the figures to receive the head of the link block pin.

The length of the block *c* is generally from one and one-quarter to one and one-half times the throw of the eccentric. This distance is measured on a straight line joining the ends *c c* of an arc drawn through the center of the block, as shown in Fig. 176.

The thickness at *g* or *k* is generally $\frac{7}{16}$ of an inch; this will make the width of the block *c* equal to twice the thickness at *g*, plus the diameter of the pin.

In a number of engines the plates *b* and *d* extend beyond the ends of the block *c*, as shown in Fig. 177; this is done to gain larger wearing surfaces. But since the extension of these plates will occasionally cause trouble in oiling the link block, they are sometimes cut flush with the ends of the block, as shown in Fig. 179.

The depth of the flanges at *h h* is generally $\frac{7}{16}$ of an inch, and we have seen them $\frac{5}{8}$ of an inch deep; but in the latter case the distance between the link arc and the eccentric rod-pin arc was greater than desirable. The plates *b* and *d* are generally made $\frac{3}{8}$ of an inch thick.

The oil hole at *i*, half way through the metal, is $\frac{1}{4}$ of an inch in diameter, and then increased to 1 or $1\frac{1}{8}$ inch in diameter, to hold the waste and oil.

LINK BLOCK PIN.

The link block pin *A* (Fig. 174) is made of wrought iron case hardened; and is fastened to the lower rocker arm. Its end which fits into the lower rocker arm should be tapered and accurately fitted into the latter. The taper should be the same as that of the valve rod-pin, as given in the eighteenth paper.

The diameter of the link block pin at *A* is generally made the same as that of the valve rod-pin. Hence, according to the eighteenth paper, the diameters of these pins will be:

For 10 and 11 cylinders	.....	$1\frac{3}{8}$ diam.
" 12, 13 and 14 "	.....	$1\frac{1}{2}$ "
" 15 and 16 "	.....	$1\frac{5}{8}$ "
" 17 " 18 "	.....	$1\frac{3}{4}$ "
" 19 " 20 "	.....	$1\frac{7}{8}$ "

Comparing these figures with the diameters of the pins in actual practice it will be found that the diameters of the pins given for the smaller cylinders agree very closely with those in use, and the diameters given for 17, 18, 19 and 20 cylinder are rather large. But it must be remembered that the diameters here given have been calculated for cylinders having steam ports suitable for piston speed of 600 feet per minute which may be required for fast passenger service, and with a steam pressure of 120 pounds in the cylinder. For freight engines in which the steam ports are often smaller than those adopted for fast passenger service, and consequently the slide valves in the former are also smaller than those in the latter, the diameter of these pins may be somewhat reduced because they will have less work to do.

The Ashcroft Manufacturing Company's Shops, at Bridgeport, Conn.

Those who are interested in machine shop construction and arrangement, will be repaid for considerable trouble in visiting the shops of the Ashcroft Manufacturing Company, recently built at Bridgeport, Conn., for the use of that company and the Consolidated Safety Valve Company. These shops are built on a lot 400 by 200 feet, bounded on each of its sides by a street; this insures room for the inevitable enlargement and the location precludes the possibility of other buildings than their own trenching upon light or convenience.

The buildings are all of brick, the main structure being 200 by 45 feet, four stories high. Centrally with this, as to length, and extending to the rear, is a large rectangular tower, reaching a full story above the main building. The different floors of the main building are reached only through this tower, from which they are separated by fireproof doors. The elevator shaft extends from the bottom to the top of this tower, the elevator having a capacity of two tons. The direction of the length of the main building is east and west, which from its location with reference to Long Island Sound, almost invariably insures a cool breeze through the open windows in the summer season.

The change from the building formerly occupied by these companies in Boston, where they had quite outgrown their accommodations, to their present commodious and well arranged shops, has permitted the introduction of special machines and appliances which they had no room for there, and more machines will be added as the necessity becomes apparent, or their utility is demonstrated.

In the lower room of the main building the manufacture of pipe tongs, pipe dies, etc., is carried on. One half of this floor is a stock room being largely used by the safety valve company. There is also being fitted up on this floor a storeroom for keeping on hand a stock of gauges, in variety of sizes, all finished except the addition of the name of the party or firm purchasing; adding this and silvering the dials will complete them. Manufacturers of boilers, and dealers in boiler appliances usually order gauges in considerable quantities, having their firm name engraved on the dials, and this stock will be kept to facilitate filling orders from them. Such orders can in this way be filled with a delay of only a day or two, instead of waiting to assemble parts and complete the gauges.

There is also a polishing room in the lower story; in this room a ventilating fan does remarkably efficient duty in keeping it free from dust, maintaining the atmosphere, apparently, as pure as in the other parts of the shops.

In the manufacture of dies the steel is obtained in bars of the requisite width and thickness. This is annealed in an hermetically sealed furnace, after which it is cut to length by the use of machines carrying gangs of mills. The dies are drilled, then tapped a little under size, after which they are channelled to give the necessary cutting edges, and to remove the superfluous thread. This grooving is done with a mill shaped like a straight fluted reamer, and at a speed that is worth observing by those interested in milling processes. When grooved the dies are again tapped, to exact size. This size is a little larger than standard, the difference being that which experience demonstrates to be equal to the contraction due to tempering. After tempering they are again tested for size and those, if any, that will not stand the test are discarded. For backing off the teeth of the dies at and near the face a little special machine is used in which the die is held in a head that can be swivelled to give any degree of clearance and taper desired. The cutting is done by means of a small emery stick running at a speed of 13,000 revolutions per minute. This operation is performed with great rapidity, and with uniformity of results.

A new machine for making pipe tongs has also been introduced. This is not of the turret type, but has a revolving head, carrying four spindles, each provided with a tool. This head is quickly revolved, and the four tools are all that are required in the operations.

One end of the second floor contains the counting room; also the office of the superintendent of the Ashcroft Manufacturing Company, Martin Luscomb, who is besides secretary of that company as well as secretary and treasurer of the Consolidated Safety Valve Company. Beyond these offices is the shipping room, then a temporary partition, the rest of this floor being occupied for the manufacture of the various styles of the Richardson "pop" safety valve. These valves are made for controlling all kinds of fluid pressure, but more particularly for use on steam boilers. They are made under the direct supervision of the inventor, George W. Richardson, who, as one of the company, and its superintendent, has an office in that end of the main building opposite the counting room. Those acquainted with the construction of these valves understand that they must be made with much regard to nicety in sizes and truth. To insure correct sizes, no less than to expedite the work, a large line of special tools are required, nearly all of which are made in the tool-room of this department. The valves are all tested before being sent away on orders, to set them to blow off at the desired pressure, and observe their capacity to relieve pressure. In the early days of the Richardson valve this testing was a matter of considerable trouble, owing to the governing parts being fixed in their positions; the valves could be readily set to blow at the required

pressure, but adjusting their capacity and operation required time and patience. Later improvements have made the operation of testing comparatively a simple matter, but there is the same necessity for testing as ever. Important improvements made by Superintendent Richardson in the arrangements for testing have also simplified the matter. A separate room in the tower is devoted to testing valves. In this room is a special shell or drum upon which the valves are placed. This shell is three feet in diameter and eight feet in length. The longitudinal seam is made a butt-joint, with covering plates outside and inside, the rivets being arranged to get the greatest strength practicable with this joint. The heads are stayed by rods, extending from head to head, secured by nuts at each end. These rods have collars, one near each end, which are faced true. The heads are put in with the flanges outside. A copper liner completely covers the inside surface of each head, extending out over the flanges. Against these copper liners the collars of the stay rods make steam-tight joints. The heads were drawn into place, and nuts on stay rods screwed up hard. Then the holes for riveting heads to shells were drilled and reamed, leaving no chance for disturbing local strains. It will be understood that there is no fire near this shell, but that there is sometimes occasion to place it under high pressure. In use, this boiler is partly filled with water; then steam is admitted from either one of two special boilers, situated in the boiler room. By peculiar arrrangements the steam mingles with the water, heating it to a temperature due the pressure of the steam admitted, making steam in this shell precisely as if it were a boiler subjected to furnace heat, only more rapidly. Means are provided for securing rapid circulation of the water at all times. It is evident that the capacity of this shell for supplying steam may be made greater or less by graduating the flow of steam to it; also that the water in the shell is an additional heat reservoir, and that the pressure in the boiler supplying steam may be to any extent consistent with safety higher than the pressure in the testing shell, or the pressure at which the valve is to be tested. By these means a comparatively small shell is made ample for testing the largest valves made; and this quality of capacity is absolutely essential to the correct testing of large valves.

The third floor of the main building is called the machine shop. This is a clear space of 200x45 feet, the floor overhead being supported by rods from the trussed roof. Here the more distinctively machine shop work for the various departments except that of safety valves is done. The "Tabor" indicator is also made in this room. There is in this room convenient for use a small steam drum for testing indicator springs. It is so arranged that the pressure to which the springs are subjected can be suddenly let on and released, simulating the action when the indicator is in actual use; the pressure can also be varied for scaling the springs.

The "gauge room" is in the fourth story. Here the gauges for all kinds of fluid pressure are assembled, and most of the work of manufacturing gauges done. The floor of this room is unobstructed except by the iron rods from the roof. Before the springs, of seamless drawn tubes, are put in place they are tested under steam pressure. While it is not intended, in use, that steam shall come in contact with the spring, it is sometimes carelessly permitted to do so. This will frequently give the spring a slight "set." To test the springs otherwise and to give them this "set," which will do no harm before adjustment, they are submitted to steam pressure.

After the working parts of a gauge are assembled they go to the workman who marks the dials for graduating, and who is provided with separate facilities for testing for vacuum, for steam or ordinary fluid pressure and for the highest requirements of hydraulic pressure. The springs are then submitted to a cold test and the dials marked. After being marked, presumably right, they are again tested for verification, and finally after being graduated they are tested once more, and if found right passed as correct.

On this floor is an apartment where, in drawers suitably marked, the various small parts of the different gauges, which, of course, are made in large quantities, are kept ready for assembling. Finished gauges and indicators are also kept in stock in this room.

Each separate room, or department has its own tool room, and necessary stock room; also wash room and all needed sanitary conveniences of the most approved kind, those for each floor being located in a room in the tower against that floor.

The floors consist of 3½ inch spruce with grooves and tongue pieces, upon which are laid 1¼ inch pine to break joints; between these are two thicknesses of specially prepared roofing paper. This is for the purpose of making the floors both dust and water proof.

All the rooms are heated by a system of overhead steam pipes, so arranged as to be used in sections or entire. This system seems to work very satisfactory, and apparently economically.

In the rear of the main building is the brass foundry, a brick building 100x60 feet, with a monitor roof. There are ten furnaces in the foundry, which with the large floor and bench space gives a capacity more than ample. The core oven is fitted with revolving table and shelves. At present a blacksmith's forge and a tempering furnace, also a small engine for driving a fan are located in the foundry. These will be removed as soon as a blacksmith shop, which will be begun early in the spring, is completed. The smithing is now done at the company's shop in Lynn.

The engine room is situated immediately in the rear of the main building, and as near centrally as to length as practicable; directly back of this is the boiler room. Power is furnished by a 65 horse-power Westinghouse engine, running 315 revolutions per minute. The belt from engine is direct to an enlarged section of the line shaft in the lower room of the main building, the lines in the other rooms being driven by belting directly up. The driving and driven pulley on each line is wide faced for both belts. These pulleys are loose on their shafts, except as they are locked by friction clutches. Throwing out the clutch in either room will stop the line in that room, the pulley running loose and driving the lines in the other rooms.

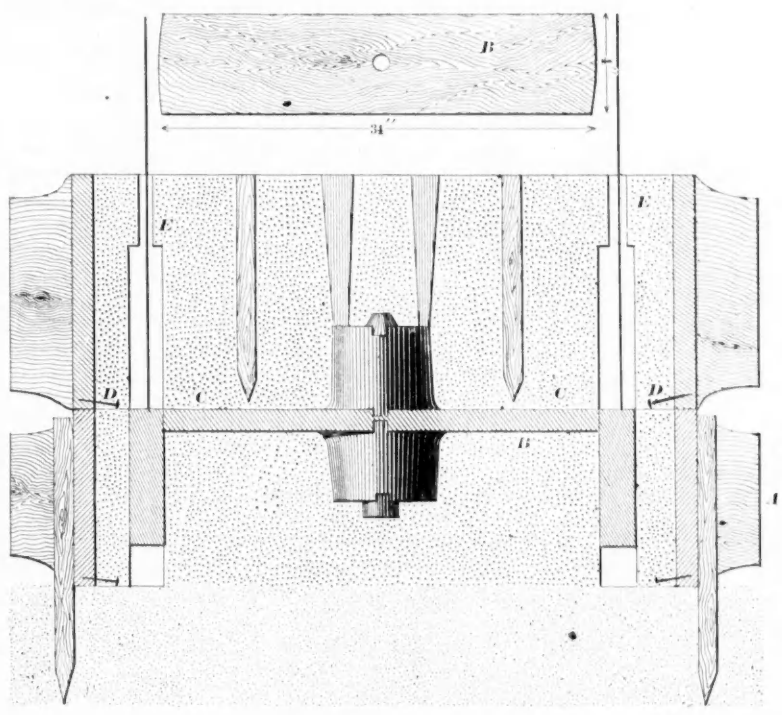
There is also in the engine room a Knowles automatic feed pump and receiver for returning the water of condensation from the heating pipes to the boiler; this was described in our issue of April 3, 1886. A Knowles steam fire pump and a Goubert feed-water heater form part of the engine room equipment.

A Babcox & Wilcox water-tube boiler, in the boiler room, furnishes steam for the engine and also for heating when the exhaust steam is not sufficient. Two boilers for use in testing safety valves, one a Whittier steel boiler and the other a Babcox & Wilcox water-tube are situated in the boiler room. Both the boiler and engine room are excellently well provided with light; in fact there are no dark rooms or corners in any part of the entire building, the whole being exceptionally well lighted.

In the upper room of the tower there are two water tanks, one having a capacity of 8,000 and the other of 2,000 gallons. The larger of these tanks overflows into the smaller one, so the large one is under any circumstances always full of water for fire purposes. When the water will not flow to the large tank from the water service it is supplied by the fire pump. To the stand pipe connected with this tank hose is attached in each room, all ready for instant use. The fire pump will also supply water to this stand pipe, a check valve near the tank preventing the water from going there.

Altogether these shops are excellently well arranged, and provided with all modern conveniences both for the workmen and for expediting work. The rooms are high, well ventilated, and cheerful.

The company have now in contemplation the erection of a separate building for offices, etc., thereby giving the safety-valve department more room, of which the need is already felt.



MOULDING PULLEYS.

Moulding Pulleys.

BY ROBERT E. MASTERS.

In the previous articles on this subject I have been writing altogether on pulleys with arms in them, but there is another class called "web pulleys" to which we will have to pay a little attention; some firms prefer this style in smaller pulleys. I know one of the largest lumber and saw mill concerns in the United States that use nothing but web pulleys of the heaviest class under 40″ diameter, yet there are comparatively few web pulley patterns to be found in any foundry. Between a set of arm pulley patterns in halves and a set of band patterns, almost any kind of a web pulley can be made; often orders for this class of pulleys are filled by cutting the sand out in the mould between the arms of the half pulley patterns; this is an easy and quick way of making a web pulley. If however among the pulley patterns that are in halves one cannot be found of the right diameter, thickness of rim, etc., the plain ring or band patterns are then resorted to.

Above is illustrated the moulding of a web pulley 36″ diameter, 16″ face from a ring pattern, 6″ face, 1″ thick, web to be 1″ thick. The pulley ring is leveled up on the floor, rammed up in the cheek *A* and drawn up 2½″; this allows the 1″ web to be all in the drag, and brings it in the center of the pulley, a piece of board cut in length to fit the inside diameter of the pulley across the center and 4″ wide, shown in plan and section *B B*, with a hole centered in it, for the hubs is bedded in the sand with the lower hub and filled in with sand flush with the board and the rim and a parting made.

Before the cope is put on the bars are cut so that the rim can be drawn up into the cope when ramming it up the same as it is drawn in the drag, securing it good with gaggers at *C C*, and having the nails *D D* in the cope extend out close to the pattern all around. After the pulley is drawn up to the right depth of face, four risers *E E* are set on top of the rim equal distances apart and the rest of the cope rammed up.

The pattern is not lifted off with the cope for the reason that the draw-holes are at the top edge. After the risers *E E* have been taken out, four wrought-iron bars are nicked with a file or marked with a piece of chalk (if the chalk has not been "banished from the shop") the depth of the cope; these bars are put into the risers, and the rim gently rapped back until it is even with the cheek, as shown; the rods are then taken out and the cope lifted off.

Before the ring pattern is drawn, the board *B* is taken out and the sand between the edge of the board and the inside of the pulley rim cut away from the rest of the web; the pattern is drawn out of the mould and the mould finished up.

The board *B* is a cheaper and easier way to make the web center than to make the whole circle for the web. This requires a great deal of work in the pattern shop, if you intend to keep it and not have it spring or warp out of shape.

If thought best, this pulley can be made on the same plan all in the floor by having the bars extend below the cope the depth that it is to be drawn up above the web.

The *Railway Review* says: "The year opens with bright prospects for a heavy demand and higher prices in all kinds of railway material. Even in the matter of locomotive engines and passenger and freight cars, contracts cannot be placed now within five or ten per cent. of the prices at which they could have been placed three months ago. A number of moderate locomotive orders have been placed during the past 30 days, and we learn that several companies are contracting for additional locomotive capacity. The makers of the best approved engines are taking advantage of the present demand to widen their margins slightly, and in so doing are following the natural course of things."

Professor Kennedy, of England, recently read a paper before the Institution of Civil Engineers on "The Use and Equipment of Engineering Laboratories." He believed that it was essential for a young engineer to get his training in the workshop, but thought there was plenty of room for practical training that fell within the scope of a scientific institution; this should supplement and complete workshop experience without overlapping it. He enumerated the following subjects for investigation as being amongst the most important: Elasticity and the strength of materials; the economy, efficiency and general working of prime movers, especially of the steam engine and boiler; friction; the accuracy of the apparatus commonly used for experimentation, such as springs, indicators, dynamometers, and gauges of various kinds; the discharge over weirs and through orifices, and hydraulic experiments in general; the theory of structures; the form and efficiency of cutting tools; the efficiency of machines; especially of machine tools, and of transmission gearing; the action and efficiency of pumps and valves; the resistance of vessels and of propellers, and experiments connected with both.

When boilers made from iron are spoken of it is understood that their worth is largely dependent upon the quality of iron used. But it is not so generally understood that there is quite as much difference in the quality of steel as of iron plates. Specifications for steel boilers should cover the quality even more carefully than for boilers made of iron. No one would expect a good iron boiler made of tank iron, yet this would be quite as reasonable as to expect a good steel boiler made from cheap material.

LETTERS FROM PRACTICAL MEN.

Difficulties in Pumping Water.

Editor American Machinist:

Noticing an answer in a recent issue of your paper to a query in regard to pumping water by suction through a long pipe, I would submit the following, if it is worth anything, to the readers of your paper.

We recently attempted to draw a small stream of water 800 feet through a two-inch pipe containing four elbows, with a good Knowles pump. The rise was about 16 or 18 feet, and was about 10 feet in a distance of 30 at the commencement. The pipe was laid carefully and was about two-thirds of the way under water, and was the rest of the way buried in damp ground, so we did not believe that it leaked. A good foot valve was placed at the further end. When we started it had a tendency to pump air which it never got over. The pump had a small cock at the foot of the air chamber, and we were obliged to leave this slightly open so as to let the air out, or the chamber would fill until the valves, which were placed high in this style of pump would be out of water, so to speak. I have thought of the matter considerably, and have often wondered if the water which flowed on account of removal of pressure by couplings and elb ws was not relieved of a portion of the air which it naturally contained, and which did not again mingle with it in the short time in which it was in the discharging chamber of the pump. The pump, if it happened to move a little faster than the water would flow into it, would upon reversing, strike the inflowing water with a considerable jar, which battered the rubber valves and made them leak, and which was aggravated when the air chamber was full enough of air to come down as far as the upper valves. The pump also worked better though a little harder when pumping against a boiler pressure than when pumping into the atmosphere, which was probably due to increased pressure upon the valves holding them down.

Now I would like to have the opinion of some one else in regard to my ideas as to the air in the water. Did the pipe actually leak, or does my experience differ from that of others who have tried a similar experiment? If it did not leak I would suggest that others who contemplate such a move be very careful to have ample room in the suction pipe to avoid friction, and also select the best pumps, and that they should be so made that the discharge would be above the valves and not below them. E. D. DAVIS.

Minneapolis, Minn.

Heat Value of Coals.

Editor American Machinist:

Your suggestion that some simple means for determining the heat value of different fuels if carried out would be invaluable, as in practice they give widely varying results. For instance it has been the practice of the writer to test various coals that were offered, and from that test determine whether to purchase that grade or not. In getting at the value all have been determined from 212° feed to pressure of atmosphere per pound coal, as the ash had to be paid for at the same price. Quoting from my note book one pound anthracite egg size evaporated 9.15 pound water, ash 13.5 per cent. Webster coal, fire about 6″ thick and spread even and but little fired at a time 9.81 pounds water, 5.68 per cent. ash. "From and at 212°" per pound combustible would make the egg coal 10.48 and Webster 10.40.

I then tried firing the Webster so as to coke it as much as possible, in this way: The fire was carried 10 to 12 inches thick, and one side of furnace was allowed to burn bright while the other was covered and allowed to coke. When the side that was burning needed replenishing cover it over medium heavy and break up the other or the coke. This method brought the evaporation up to 10.63 per pound coal, and other tests showed about the same difference between the two ways of managing.

Another cargo of same coal was only able to give 10.33; while mixed with anthracite dust it gave 10.12.

Other kinds of coal gave as follows: Reynoldsville coal, a gas coal which made so much gas the furnace could not manage it, 9.11; George's Creek Cumberland, 10.84; Pocahontas, 10.70; Elk Garden Cumberland, 10.46.

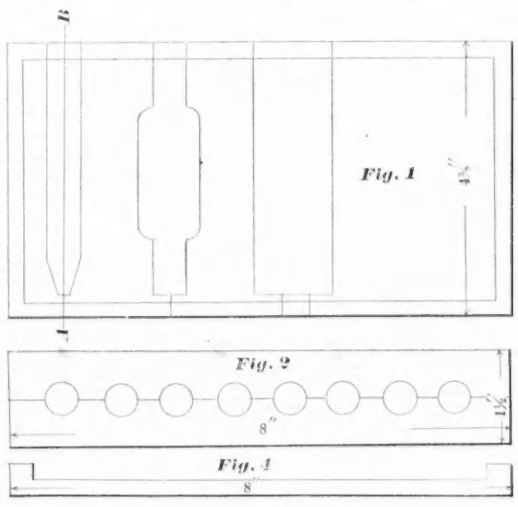
These tests were made with a 50 horse-power Harrison boiler, and about 12 pounds of coal were burned per square foot of grate which had slightly over 50 per cent air space. Each test was continued two days under actual working conditions, and included coal for banking fires, etc. Difference between flue gas and boiler room about 380°. Not knowing the heating value of the different coals, I am uncertain how near the full value these results are. In one table the value of anthracite coal, or combustible is put at 14,500 heat units; Cumberland, 15,370; and coking bituminous, 15,837.

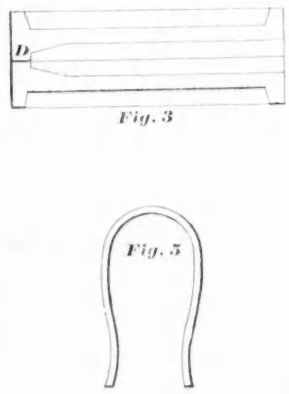
W. E. CRANE.

Core-Box and Core Making.

Editor American Machinist:

In a foundry of which I had charge they used thousands of bevel gears and small pulleys, all using ½″ cores. The cores kept a large boy busy about all the time; they were made in a wooden box, which in a short time became so worn that it was impossible to get a good core. I had an iron box made like the accompanying sketch. I then had all the prints on patterns using that size core altered so as to use all one length, thus saving the labor of cutting them to a length. There was no further trouble with those cores; they came round and straight every time. The box illustrated was made for a core 4″ long. Fig. 1 shows elevation; dotted lines show some of the various styles of cores that can be made. Fig. 2 is a plan and Fig. 3 a section through *A B*. Fig. 4 is a plate for drying these cores. The flange on end should be half the diameter of core. Fig. 5 is a clamp for the ends of the box while ramming up the cores. The line *D* in sectional view shows vent-hole through bottom of box. After the cores are all rammed up, the box is turned over, and they are vented from the bottom.





W. P. BRYAN.

A Small Cupola.

Editor American Machinist:

Some time since I read in the AMERICAN MACHINIST an account of melting iron in a ladle. I thought I would try it. There had been a failure of another man the day before, but I thought that by a little addition I could succeed. The effort was a grand failure, not as regards melting the iron—that was melted, but when I came to pouring it had set in the bottom of the ladle.

One day after that a break down job came in, wanted that day. I was not going to cast that day, so I thought I would try another scheme. I found two sections of an old smoke stack, each about 2 feet long by 18 inches diameter. I cut two holes, one for tapping out and the other for a tuyere. I shoveled some sand from front of cupola and mixed it into a mud and daubed up the sections, placed a flask near the blacksmith forge, filled it up with rubbish and set one of the sections on it, with a piece of sheet iron through the front hole for a spout. I then made up the bottom and put on the top section, stopped up the joint between them and put in the fire. I got the blast from the pipe at the blacksmith's fire. The cupola was made, the iron melted and the piece moulded and poured before noon. I used that cupola several times afterwards, having taken as much as 1200 or 1500 pounds of iron out of it.

THOMAS WATHEY.

A Small Cupola.

Editor American Machinist:

Being interested in the accounts of small cupolas, published in your paper, we concluded to try one. Six months or more ago we built one 19″ inside diameter, and have been running it steadily ever since. Average work is 1 lb. coal to 10 of iron. The largest single piece poured was 1,470 lbs. The largest total of clean castings from one heat, 4,750 lbs. Have just poured a bed plate 1,300 lbs. Iron was melted in about 1¼ hours. All scrap iron used. Fuel, hard coal, grate size. Fan 24″ diameter; 1,800 revolutions. C. T.

A Presentation on Retirement.

We recently noticed that the Cuyahoga Works, of Cleveland, O., had sold out to the Cleveland Shipbuilding Company. J. F. Holloway, President, and Thomas McClure, Secretary of the old works, retired from active business relations with the concern. The occasion was observed by the employes of the works by presenting a fine bust of Sir Walter Scott to the former, and a gold-headed cane to the latter. Thomas D. West, foreman of the foundry (who remains in that position), made the presentation address, which was very appropriate.

"I supposed," said Mr. Holloway, in reply, "when I made the speech to you which conveyed the information to you that the old Cuyahoga Steam Furnace Company was no more, it would be the last time that I should address you. This scene is in some respects the saddest of my life, and while the parting is attended with the keenest regret, I cannot but believe that the change will be of advantage to you all. In my past connection with you I have always tried to do what was right and to deal justly by both my men and their employers. If I have failed in this, it has been the fault of the head and not of the heart. Since I came among you, nearly a quarter of a century ago, the changes have been many, but I cannot speak of this. Many of you have grown to manhood in my employ, and the thought as expressed by Mr. West, that I have been instrumental in making your lives pleasanter, is one of the pleasant thoughts of this hour. When the firm went out of existence, my only fear was that, perhaps, some of you would be deprived of your situations; but when I was assured by the new management that all the men would be retained, it brightened the pleasures of the new year. I don't know how I can thank you for this handsome present, but permit me to assure you that it will ever be cherished as a reminder of the kindly feeling that has always been shown me, and which I hope will continue." Mr. McClure thanked the men briefly for the cane, and said he would ever think of the men and "old Cuyahoga."

Quick Setting of an Engine.

A few years since a 24″x48″ engine was to be put in the works of the Union Metallic Cartridge Company, at Bridgeport, Conn., to replace the engine then in use. To do this the old engine and foundation must be removed, a new foundation built and the new engine placed. Mr. W. F. Durfee undertook the job, and in five days and eight hours from stopping the balance wheel of the new engine was turning over. The foundation, except at and near the top, was made of rubble. These stones were roughly placed together and marked before stopping the old engine. A templet was also made with center line and bolt holes accurately marked. In the centers eye-screws were placed, and the templet made fast overhead, so that lines let fall from these eye-screws indicated corresponding positions on the foundation. We recently saw this engine in operation, and the superintendent of the Works, Mr. A. C. Hobbs, called attention to the fact that he had never been able to detect the least particle of movement of cylinder or pillow block on the foundation.

This engine carries two 36-inch belts from the fly-wheel pulley, 15 feet diameter, to two 7 foot pulleys on the jack shaft. They drive as evenly and smoothly as if but one belt was used.

Quick Mechanical Work.

When the steamship Alaska arrived in this port it was discovered that the piston was cracked; it was also evident that the return trip to Europe could not be made with the piston in this condition. The piston was 100 inches in diameter and 16 inches deep. On Tuesday evening, 18th of January, an order for a new piston was sent to the Delamater Iron Works of this city. At 7 o'clock of the same evening men from the Delamater Iron Works took measurements of the piston on board of the ship. At 7 o'clock of the following morning the sweeps for the piston were sent to the foundry, and it was cast on Friday evening at 5 o'clock. During Saturday the casting was allowed to cool. On Sunday morning at 7 o'clock the piston was placed in the boring mill, and Monday evening at 6.30 o'clock it was turned, drilled, completely and successfully finished. At 7 o'clock of the same evening the piston was in the cylinder with all the nuts screwed down, and the job was finished. On the following morning, Tuesday, 25th of January, at 5 o'clock the ship started for Europe with a new piston weighing 13,000 pounds. Considering the size and weight of piston, and also remembering that no pattern for the same was on hand, it must be admitted that this piston was very quickly cast and finished. The energetic management of the Delamater Iron Works deserve great credit for showing our English cousins what American workmen can do; and we believe that this record cannot be beaten on the other side of the Atlantic.

Previous to 1882 the cost of an engineer's license from the inspectors of steam vessels was from $5 to $10, according to grade. In 1882 it was reduced to 50 cents, and in 1886 the fee was abolished altogether.

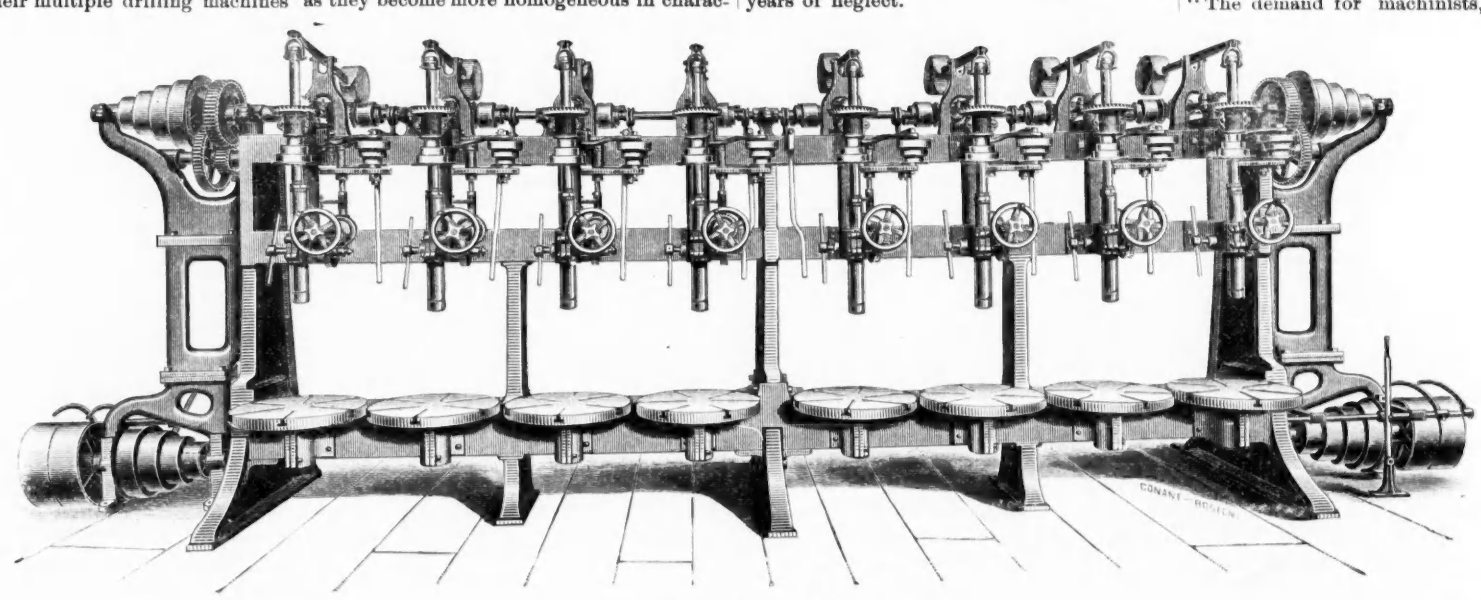
The *Railway Age* tabulates the railway mileage of 47 States and Territories on January 1, 1887, and finds the total to be 137,500. Illinois stands at the head with 9,579 miles, and Rhode Island at the bottom with 210 miles. Iowa stands second with 7,907 miles, Pennsylvania third with 7,817, and New York fourth with 7,466 miles.

The *Albany Journal* says: "It is never safe to enclose an old greenback in a letter. * * If you will notice an old greenback it has a peculiar smell about it that can readily be perceived even if enclosed in a letter." With all deference to the sense of smelling lodged in the editorial sanctum of the *Journal*, we suggest that the Post Office clerk, or letter carrier, who could not tell without smelling whether a greenback, old or new, was enclosed in an ordinary letter must have a phenomenally poor sense of feeling.

Multiple Drilling Machine.

The accompanying cut is a representation of a multiple drill having eight spindles, all entirely independent of one another as regards rotation or feed. All are provided with power feed having three changes, and so arranged that it can be made as fine or coarse as the user may desire by simply changing the relative sizes of a pair of change gears. All spindles are also provided with a quick return lever at the left of the spindles. This lever can be moved through the butt in which it is held, thus enabling the operator to vary its length and use it for light drilling or other work; it is secured against slipping by a thumb-screw. The spindles are arranged in sets of four, each set being driven from a transverse shaft at the back of the machine that is provided with a four section cone of large diameter and beltface and back gears; this shaft imparts rotation to the spindle through a simple efficient and easily working friction coupling. Each spindle is accurately balanced by means of the link lever and weight shown at the top, and is so held in the quill that it is impossible for it to drop suddenly, as the drill point begins to break through the metal at the bottom of a hole. The machine shown will drill without straining a 2-inch hole out of solid steel and other metals proportionately.

The makers, Prentice Bros., of Worcester, Mass., make their multiple drilling machines



MULTIPLE DRILLING MACHINE.

with as many spindles as desired, with heads stationary or can be moved to any desired distance from center to center—8″ ordinarily being the smallest distance, though they have built machines in which the spindles approached to within 3 and 5 inches of one another. The feed can be made independent or not as desired, and the table either as shown in the cut or running the entire length of the machine. These machines are built of all sizes, corresponding to the single spindle machines of the same makers that range from 12″ to 50″ swing. The first of the style of multiple drills shown was built for the Silver & Deming Manufacturing Company, of Salem, O., and used by them in the manufacture of pumps, and is in use at present and giving great satisfaction. The machine illustrated in the cut is at the works of McConway & Torley, Pittsburgh, Pa. The weight of this machine is eleven tons.

Suggestions in Machine Design.

IV.

BY A. J. SHAW.

Bearing, instead of being, as is too often the case, the weakest should be the stiffest part of the shaft; many bearings give trouble by heating or cutting from this cause alone.

Long bearings wear long.

But increase of length beyond a certain limit is of little, if any, value, especially if the diameter be not increased at the same time.

A bearing which deflects in its own length is of less value than a smaller one which preserves its form.

Nothing is gained by making bearings large, and then necking down at their ends so deeply that the angle of the shoulder is inside the parabola forming the line of "uniform strength."

An engine lathe, from one of the best shops in the country, has a spindle the front bearing of which is 2½ inches in diameter, but necked at either end for face-plate and hub of back gear to 1¾ inches. For a bearing of this diameter the neck should have been not less than 2¼ inches, as a minimum, in order to develop the full strength of the spindle, or if the neck be assumed as correct the bearing should have been not over 2 inches, while 1⅞ inches in diameter would have answered every purpose.

Sudden large reductions in diameters of shafts carrying transverse loads are elements of weakness; not only are the strains concentrated at the necks, but the tendency is to, and there is danger of, cutting below the line of uniform strength.

That machine is best proportioned in which the stresses are most equally distributed among all its parts.

There is a constant tendency in modern designing, where equality of strength rather than stiffness is the end sought, toward the use of smaller nominal factors of safety, and this is allowable with no actual decrease in the safety of the completed structure, as we acquire a better knowledge of our materials as they become more homogeneous in character, and as more care is taken in the distribution of stresses.

The stresses per square inch allowable in good practice on wrought iron, and the so-called mild steel has gradually increased until it has reached as high as 14,000 to 16,000 pounds for medium sections for quiescent loads.

For intermittent and suddenly applied loads the allowable stress decreases, running down to 6,000 or 8,000 pounds or lower, for loads which reverse in direction.

Factors of safety have been called "factors of ignorance," but it would be hardly just to judge a designer's ignorance by the size of his factor of safety.

The factor of safety varies not only for different materials, but also for the same materials under different conditions.

When the breakage of a part would do little damage, a lower factor is allowable than if its failure would be disastrous.

When failure would be likely to involve loss of life, safety should be secured at any cost, as far as it is attainable.

This is the prime requirement, a failure to meet which cancels all other merits, no matter how great.

It is but a few weeks since the drum of an elevator in Boston crushed like paper under the coils of the hoisting cable; the fall of the car seriously injuring three persons, two of whom have since died.

The inscription on their tombstones should be "Murdered to save $5.00."

There may be some excuse for the neglect to provide safety devices on hoisting machinery of this class, as there is so much doubt as to their effectiveness when most wanted, but for the criminal recklessness of the elevator manufacturer, who, for the sake of saving a few pounds of iron, will make so important a part of such a machine unsafe, there can be no excuse whatever, no matter how keen the competition.

That many of the cheaper kinds of elevators are dangerously weak is notorious to those engineers who have had occasion to examine them.

No safety device is likely to be of service when wanted, which is either complicated or likely to get out of order. They are never in use, except in case of accident, and not being used are abused, at least by neglect.

Except on the higher class of passenger elevators the safety devices are never inspected, and even when known to be out of order are seldom repaired.

Neither are those likely to be effective which are designed to stop the car with a sudden jerk after it has dropped two or three feet, or which depend for their action on the slackening of the hoisting cable.

Only those are reasonably safe which are put in operation by any acceleration of the speed of the car above a certain limit, from any cause whatever.

The conditions of a "trial trip" are different from those obtaining in actual service in this as in many other classes of machinery; and effectiveness at that time must not be accepted as proof of equal efficiency after ten years of neglect.

Offset levers and other parts subjected to a combined bending and torsional stress are best made of a section approaching the cylindrical.

When possible, the heaviest loads should be carried nearest the points of support.

In a certain machine tool a cone feed-pulley carries on its hub a small pinion both running loose on a stud some six or seven inches long. The pinion is at the outer end of the stud, although there is no visible reason why it should not have been placed at the inner end, thus reducing the large bending moment, which at present exists when carrying a heavy cut.

Perhaps the designer first sketched it in that way, and did not care to take the trouble to change his drawings.

Many indifferent arrangements go into the shop, and are in use, for this reason alone.

Don't be afraid to make changes in your drawings before they go into the shop. It is better to make alterations yourself before, than to allow some one else the chance to suggest them after the design leaves your hands.

Criticise your own work most severely; even then you may be sure that after you have discovered all its faults, the first man who looks it over after you, will find another and suggest a change.

Designers who do not criticise their own work, but see it only to admire, generally advance in knowledge like a crab, sidewise.

Never prefer your own ideas to better ones of others, simply because your own are your own.

Do not let your judgment of the work of another be influenced by the personality of the workman.

Consider the merits of a suggestion, not its source.

For this reason a rotating shaft should be larger than a stationary stud or bar carrying the same transverse load.

The laws governing the action of reversed and intermittent stresses are not perfectly known, but it may be assumed as sufficiently accurate for practical purposes, in the case of alternate loads, to take double the nominal load as the total on which to base calculations.

In high speed machinery account must be taken of the strains set up by the action of heavy parts in motion.

Do not assume that, because a pulley or gear is turned all over, it is balanced.

Symmetry of form is not always an indication of uniformity of material.

Notes from Wage-Earners.

A reader in North Platte, Neb., writes: "Here in North Platte, machinists' wages run from $3.35 to $3.50 a day; good blacksmiths, $3.75 to $4.00; boiler makers, $3.50 to $3.85. Still there are drawbacks to this State. There is no use in an Eastern man coming out here on spec. The companies hire no new men. Sacramento, San Francisco and Denver are full of idle men. Many skilled workmen from the East have to take laborers' jobs.

A correspondent in Newport, Ky., writes: "The demand for machinists, tool-makers, etc., does not seem to be equal to the supply, but an average man can always get $2.25 or $2.50 a day, *i. e.*, I mean an average machinist. A took-maker's wages depend upon the job he "strikes," I have known them to get $5.00 a day—on special work—and have known good men to work for $2.00 a day when hard up. All the shops seem to be running full time so a man who has a job can make full time. There is no busy "hurry up" season with a corresponding dull season. I think the cost of living here is very moderate.

A correspondent in Lowell, Mass., writes: "In this city the wages vary from $1.25 to $2.00 per day. A tool-maker or expert on planer or some specialty may get $2.00 per day if he fights hard for it. I don't think that they pay more than $1.75 on any of the corporations to machinists. They (the machinists) must feel proud. The laborers on the streets now get $2.00 per day in this same city.

Sir Joseph Whitworth, the celebrated English engineer and manufacturer of machinery, died recently at the age of 84. He was born in Stockport, England, acquired his mechanical training at Manchester, where his extensive works are now located. As early as 1851 his improvements in iron planers and other machine tools attracted considerable attention at the World's Fair in London. He was a commissioner to the World's Fair in New York in 1853. In 1854 he began to make breech-loading rifles and cannon, and his success in this line is well known. He was made a Baronet in 1869. He was a great advocate of standards in machinery, and successfully introduced into England the Whitworth standard screw thread, with which our readers are familiar. He was an author as well as an engineer, and has published several works on mechanics.

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NEW YORK, FEBRUARY 12, 1887.

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Competition in Securing Manufacturing Establishments.

Competition among cities and villages in efforts to secure manufacturing industries is becoming an important feature of the industrial situation. This competition takes the form of offering bonuses of different kinds. Sometimes natural advantages for manufacturing are quite prominent in a city, but it is safe to say that the attractive power of natural advantages is much less than it has been.

Even the advantage of water power, in any well settled part of the country, is regarded with much less favor than it formerly was. Modern improved steam engines, with fuel at moderate prices, find no difficulty in competing with the best water powers in the land. Transportation facilities are so well provided by our 137,000 miles of railroad and numerous water routes that few places aspiring to possess industrial establishments are without adequate means for shipping materials and products. When unjust freight discriminations are ended as the people hope they will be after the Inter-State Railway Commission gets at work, there will be still more equality among towns both large and small in competing for the acquisition of manufactories. General advantages are, with few exceptions, secondary to the enterprise of citizens who create inducements to draw productive industries. It has been well proved that the citizens of almost any town or village having, say not less than 5,000 inhabitants, can attract manufactories if they act together with enterprise and enthusiasm. The greater the bonus offered the more likely they are to secure what they want.

Until lately competition to secure factories has applied almost altogether to those about to start new establishments. The keenness of this competition, and the consequent enlargement of pecuniary inducements have recently drawn many old industrial establishments from their original quarters to new localities, and the further awakening of local enterprise in towns wanting manufactories will have a still stronger influence in persuading established industries to move. To what extent this competition will go is just now an interesting problem. Of the multitude of manufactories in this country many are not satisfied with their location, and await some good offer to move. Among the ordinary inducements offered are land for building sites, subscription to stock, exemption from taxes for ten years, buildings rent free for ten years, and direct donations of money. In some cases buildings are presented free, and in other cases free fuel and free machinery are offered. Associations are forming in many towns to raise whatever bonus can be obtained, and to invite manufacturers in the most persuasive way to locate there. As the accession of substantial manufactories, especially to smaller towns, adds not only to the aggregate wealth of the town, but increases the prosperity of all kinds of legitimate business located there, and as this fact is becoming better known and appreciated, the spirit of progress is likely to be more active for the next few years than ever before, in competing for the location of desirable industrial establishments.

Private Armed Forces in Industrial Disputes.

In our issue of May 19, 1885, we published an editorial with the above heading, which in view of subsequent occurrences we have thought desirable to repeat. We do not know of a single daily paper that expressed this view of the subject at that time, but recently several of them have taken the same ground upon the question Since that editorial was published, gangs of "private detectives" have committed murder at East St. Louis, at Chicago, and at Jersey City, while ostensibly preserving the peace. What we said in May, 1885, was:

"Recent occurrences at several places in the West have brought a problem to public notice that has not heretofore been pressed to the front. Several large and powerful railroad and mining corporations, after getting into a conflict with their employes over labor matters, causing the latter to withdraw from work, have immediately engaged gangs of "private detectives," fully armed with the most efficient modern weapons, to "protect their property." At first thought, this course may seem to be justified by existing conditions, when viewed in the light of occurrences that have followed similar disputes on other occasions; but examined a little closer, it will be found to have a different significance. All citizens are entitled to adequate protection of life, liberty, and property under the law, but the possession of large property does not carry with it the right, in this free country, to use any force for protection denied to the poorest and humblest individual. Efforts are always made to have these companies of armed "detectives" sworn in as special policemen, while acting under pay of the corporations. The feelings of a lot of workmen, who are guilty of neither violence nor pillaging, but who are peaceably waiting for a settlement of the dispute which caused them to be idle, upon being threatened and bullied by a gang of armed men brought from a distance, and acting under cover of law, can better be imagined than described. In such cases workmen are apt to give emphatic expression to their opinions upon such proceedings, which are caught up and recorded by the daily press as "mutterings and threats of agitators that are in danger of breeding riot." Any collision resulting from such provocation is sure to be depicted for the information of the public in a way greatly to the disadvantage of the workmen. Fortunately, the civil authorities are seldom led into the inexcusable blunder of commissioning an armed force engaged by a private corporation as special policemen. When the usual police force is not sufficient to preserve the peace and protect everything that needs protecting, other resources are provided by law that can be made available. No party to an industrial dispute should ever be allowed to have its armed retainers authorized by legal power to stand guard over or menace the other party to the same dispute."

Luxuries Wanting Exemption from Taxes.

Some newspapers are making great efforts to have national taxation reduced so as not to accumulate a surplus in the treasury. Some are in favor of reducing the tariff entirely ignoring the fact that whenever the tariff has been materially reduced importations have so increased as to swell the funds in the treasury. Others again are making such a crusade for the utter abolition of duty upon works of art, that the reader is induced to stop and think where their inspiration probably comes from. The fact is plain enough that poor people do not buy fine paintings, bronzes, ceramics, and the like, because they have not the means to do so. Such luxuries are exclusively confined to the rich and well-to-do. It would save the millionaires who buy the expensive works of art a very respectable sum every year if they could get the tariff removed, and it is evident that they have a very strong "pull." It would be more pleasing, however, to the masses of people to have Congress remove the internal revenue tax on the poor man's solace—tobacco.

Boycott the Postal Note.

When the United States postal note was first introduced, many persons were prepared to regard it as a desirable method of transmitting small sums of money safely through the mails. Many such have already found out their error.

Every one who sends bank bills or postage stamps through the mails knows that he does so at his peril. Not so with the postal note. It is procured from the postal authorities specially for the purpose, a fee of 3 cents is paid for its use, and probably no small percentage of the persons adopting this method of transmitting money do so with the vague idea that its governmental origin implies some degree of safety in its use.

But it is not safe. In fact, it is a swindle, for no matter how well it is known by the post-office officials that a particular postal note has been lost or destroyed, and that its amount remains undrawn from the Government vaults, no duplicate can be procured under the law, and the money is forever lost to both the sender and "sendee."

A recent regulation of the Post-Office Department permits postal notes to be taken out, which are in set terms made payable at "any money order office," still further increasing the risk of using this unreliable means of transmitting money, as the pilferer who wrongfully comes into possession of such a postal note is thereby afforded unlimited opportunity to get it cashed without chance of detection.

When a post-office money order, which is absolutely safe (duplicates being readily obtainable) can be procured for 5 cents, there is no excuse for adopting such an unreliable substitute.

By all means, boycott the postal note.

We are pleased to hear that Prof. R. H. Thurston, the head of Sibley College of Mechanic Arts, Cornell University, has had an interview with Hiram Sibley, its founder, which will result in a donation of $250,000 to the college. This amount will be used for enlargements and improvements. A number of additional students can be instructed after this expenditure has been made. Technical education is certainly making progress in this country. As Prof. Thurston has been connected with the college less than two years this donation shows that his work must be quite satisfactory.

An effort is being made to get Congress to give away part of the surplus now in the treasury to corporations, syndicates and individuals engaged in shipping. This is called the bounty plan to encourage American shipping. It is a very bad plan, and we hope it will not prevail. The people are tired of bounties and subsidies to railroads, shipping lines, and other industries. Beside being an injustice to the people at large, bounties and subsidies have always worked evil. Let us have all the protection the Government can give, but no subsidies.

A reader wants to know if our office is open in the evenings, as he wishes to call upon us then. No: the AMERICAN MACHINIST in its early days declared its opinion that eight hours is the proper limit for a day's work, and it has always conducted its business upon the eight hour plan, with early quitting every Saturday, and a Saturday half-holiday in the summer. It probably takes more hands to do the required work in eight hours than it would in ten, but we have no fault to find with the system and shall continue it. We never expect to be obliged to come to the ten hour plan because any of our esteemed contemporaries work ten hours a day.

This is a bad season for monarchs. The sheriff seized the Lydian Monarch, then the Celtic Monarch was abandoned at sea, and there are a few monarchs in Europe who will have occasion to call the sheriff to collect the taxes if their enormous expenditures for military and naval purposes are kept up.

One Way to Make a Full-Size Drawing.

When a man without skill in interpreting scale drawings builds a house he is likely to be somewhat disappointed in the results. The small drawing has very likely conveyed impressions of the interior arrangements that the finished house does not satisfy. The judgment has not been trained to receive impressions in feet and inches, but rather by space, without much reference to measurements. We recently heard of a gentleman who got around this difficulty in a manner satisfactory to himself. An architect submitted plans for a large house, which as usual in such cases the gentleman failed to fully comprehend. By using bricks he had a full-size representation of each floor laid out on his lot, the walls and partitions being one brick high, and actual thickness. By walking around through these representatives of rooms and passages he was able to get things to suit him.

Discouraging to Free Traders.

The Brooklyn *Eagle*, which has always been an active opponent of our protective tariff, is forced to admit that the popular tendency is directly contrary to the policy it advocates. In a recent editorial it says:

"The tendency of change within the Democratic States is toward protection, especially in the South. The fixed opinion of the doubtful and pivotal States, New York, New Jersey, Connecticut and Indiana, is for modified protection. The cities of those States, as manufactures lap over commerce, are becoming the same. The balance of power party, the Labor party, inclines that way too.

"These are facts. The *Eagle* wishes the facts were otherwise; but they are facts, and politics has to take facts into account."

One of the peculiar features of the coal handlers' strike on the Jersey shore is the appearance of non-union unions. The press informs us that the Harbor-master ordered all the union boats out of the slips and that their places were filled by the boats of the "Non-Union Boatmen's Association." Such an anomalous organization must resemble a non-adhesive sticking plaster. Perhaps in time we may have the Non-Combination Coal Companies Union or the Anti-Pooling Railway Earnings Division Association. When it comes to forming unions on strictly non-union principles the exigencies of the occasion must be boldly met.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(46) C. A., Troy, N. Y., writes: We have put in steam heat, and are troubled with water. The bottom of our radiators are about six inches higher than bottom of boiler. Is there any way to get rid of this water? *A.*—The best plan is to put in a return steam trap.

(47) Y. H., Indianapolis, Ind., asks: Has there ever been a baloon of any kind made that will ascend and descend to any height as often as desired, and if not, would an invention which accomplished this be of value? *A.*—It has never been accomplished. Such an invention, if its use were practicable, would be of value.

(48) J. M. S. writes: Could you inform a young machinist to whom he could make application for a position as locomotive fireman? *A.*—We do not know of why vacancy at present, but we would advise you to make your application to the superintendent of motive power of road on which you would like to work, or on which you see a chance of obtaining employment. If he is not the man that hires the firemen, he will know if any are needed, and direct you where to apply.

(49) J. R. C. writes: Will you please inform me where I could obtain a table of natural sines, tangents, etc., for every degree and minute of the quadrant, and also of a simple method for finding the length of the chord of an arc by means of logarithmic sines, tangents, etc.? *A.*—You will find the table of natural sines, tangents, etc., in any good engineers' pocket book, such as Trautwine's, Haswell's, Nystrom's, and a number of others. Methods for finding the length of the chord of an arc you will find in Davies' Legendre or Loomis's Geometry.

(50) W. U., Modesto, Cal., asks: 1. What power should a 9"x12" slide valve engine with a fixed cut-off develop with 140 pounds steam pressure, running at 200 revolutions? *A.*—If a well-constructed engine, it should develop 50 to 60 horse-power. 2. What size double engine, fitted with good link motion, running same number of revolutions, with same steam pressure, would do the same work? *A.*—7"x12". 3. How are letters formed on steel stamps? *A.*—They are cut out with chisels and files, a die or mother being used to give the form. We cannot tell you how to utilize your refuse lard.

(51) J. Q. writes: As I understand it, the functions of a valve stem requires that its motion be entirely upon its own centre line. But as the point of the rocker to which the valve stem is attached describes the arc of a circle, a false movement is thereby imparted to the valve stem. Has anything been devised to correct this, or is it considered of no consequence? *A.*—Engines having comparatively long valve stems, the false movement caused by the rocker is considered to be of no consequence. When the valve stem is short, a knuckle joint must be adopted, as illustrated in the AMERICAN MACHINIST, February 13, 1886, page 4.

(52) G. P. D., San Francisco, Cal., writes: 1. I have a boiler 11½ feet by 40 inches, with 34 tubes 2¾ inches diameter. There are no stays except in the dome, which is 4 feet by 2 feet. In this there are four stays ⅞ inch diameter, passing through it in a horizontal direction. Is the boiler properly stayed, and what is the safe working pressure, the shell being 5-16 inch thick? *A.*—The presumption is that the heads should be stayed, and possibly the head of dome. We can tell nothing about it without full description of the boiler. You do not give the tensile strength of the material of which the shell is made. We are entirely in the dark. 2. Do ocean steamships use salt water in their boilers, or how is the salt extracted? *A.*—Ocean steamships use surface condensers in which the steam used in the cylinders is condensed, and the water returned to the boilers.

(53) E. H., Peoria, Ill., asks: Will you please answer the following questions to settle an argument? 1. What is generally the weakest point of a tubular boiler—the flue sheet or the crown sheet? *A.*—In boilers which are correctly constructed one part is as strong as another, but the crown sheet being exposed to the greater heat, will require more care and attention. 2. If the form of a boiler head is a perfect circle, would it stand a greater pressure than the other sheets of the boiler, all being made of the same material and the same thickness? *A.*—We do not quite understand this question. If you refer to a flat boiler head, whose periphery is a circumference of circle, it must be braced so that it will be as strong as the other parts of the boiler. If you refer to a spherical head, it will not need to be braced, but it will not be any stronger than the other parts of the boiler, because the shell will be as strong as that part of the head which is riveted to the shell.

(54) J. W. V. writes: Please inform us how to galvanize iron castings? *A.*—Cleanse the castings in a tumbling barrel; when thoroughly clean, heat the castings one by one, and then, while hot, plunge them in a liquid composed as follows: Ten pounds hydrochloric acid, and sufficient sheet zinc to make a saturated solution In making this solution, when the evolution of gas has ceased, add muriate, or preferably sulphate of ammonia, one pound, and let it stand until dissolved. The castings should be so hot that when dipped into this solution and instantly removed they will immediately dry, leaving the surface crystallized like frost on a window pane. Next plunge them while hot, but perfectly dry, into a bath of melted zinc, previously skimming the oxide on the surface away, and throwing thereon a small amount of powdered sal-ammoniac. If the articles are very small, inclose them in a wrought-iron basket on a pole, and lower them into the metal. When this is done, shake off the superfluous metal, and cast them into a vessel of water to prevent them from adhering when the zinc solidifies. Besides this, you will need an experienced man to do the work successfully.

(55) G. T. C., Vineland, N. J., asks: What is the cause of hard spots at the corners of small, thin, gray iron castings, and how can they be prevented? Can they be made soft by annealing, and at what expense? Where can I find a description of such a furnace for a small quantity of castings? How long is it necessary for castings ½-inch thick to remain in the ovens to become thoroughly malleable? What material is used for moulding to produce the finest, smoothest castings? What metal can be used to obtain the best castings for patterns which will require the least work in finishing? We have been troubled in getting soft, perfect iron castings, and would like to know if they can be made from gray iron. *A.*—Mr. L. C. Jewett replies as follows to these questions: "The cause of hard corners and extremities of small, thin gray iron castings arises from the fact that the metal cools more quickly at those points; the too rapid cooling is sometimes—in fact, often—hastened by excessive swabbing of water around the pattern before drawing. I have known oil to be used around pulley rims to prevent that portion of casting being too hard. The castings can be made much softer by annealing at a cost of from one-half cent to one cent per pound, after the oven is constructed; the greater the quantity the less the cost. The length of time depends on the thickness; ½" would or ought to be in good soft condition, and uniformly so, if annealing pots are kept at cherry red for six or eight days; that depends, too, on sizes of pots and quality of iron that castings are made of. The best material to make fine neat castings that are now in use is No. 1 fine Albany sand; it should be prepared before putting in the moulder's heap by sifting when dry and new through a No. 32 sieve, and then sifted when tempered through No. 10 or 16 sieve. The castings should be rattled until sand is off before annealing. After that they should be rattled in a tight rumbler with bits of leather, pieces of cork, and if to be obtained old (brass foundry or steel) crucibles broken up; they will then be very smooth. I have seen crocus used, but old crucibles will satisfy most any one, and cost less. All things considered, brass as composition makes the best patterns, as they finish up easily and can be soldered on to gates and easily repaired; this is for small metal patterns, of course. There is great care to be used in the mixture of the iron to make good, soft, even and smooth castings. The iron used will affect the surface of the castings, and the right kind is not always obtainable in all localities, and the mixtures have to be tried until the Eureka is reached." Illustrations and descriptions of annealing furnaces can be found in the AMERICAN MACHINIST of May 12, 1883, and Jan. 19, 1884.

Business Specials.

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

J. Clayton, Air Compressors, Rock Drills, 43 Dey st, NY

Edw. Sears, Wood Engraver, 169 William st., N.Y.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Patent and construction drawings. D. P. Palmer, 5 Dey street, Room 3, N. Y.

N. B. Non-breakable Drills and Taps. A. P. Brown, 108 Liberty st., N. Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., NY.

20", 25," 28" B G. and S. F. upright drills for immediate delivery. Currier & Snyder, Worcester, Mass.

Ice and Refrigerating Machines. 120 built, and all successful, by David Boyle, 521 Monroe, Chicago, Ill.

Robbs' Patent Composition for case-hardening; send for circular. F. W. Tasney, Paterson, N. J.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co. 111 Liberty st., N. Y.

Engine Lathes, Hand Lathes, and other fine tools, Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

Steel Stamps by mail, 13c. a letter; figures, 80c.; and letters, $2.25 a set. Acme Tool Co., 16 Jennings avenue, Cleveland, Ohio.

Curtis Pressure Regulators, Curtis Return Trap. Curtis Damper Regulator. See Feb 5, p. 11. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

Machinists' supplies, brass goods m'f'rs supplies, polishing materials, all kinds wire, metals, etc; in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

Handbook on the Care of Boilers. 50c. Descriptive Circular and Catalogue of Books for Mechanical Engineers free on application; special terms to Mechanics' Libraries. E. & F. N. Spon, Publishers, 35 Murray st., New York.

"Hints to Steam Users, Engineers and Firemen." A 100-page book on care of steam boilers; just issued; containing useful rules, tables, etc.; a valuable book for engineers; sent on receipt of 25 cts. in stamps. J. N. Mills Pub. Co., 30 Vesey st., N. Y.

St. John Improved Self-adjusting Cylinder Packing, for marine and stationary engines and locomotives; applicable to water, air, oil and ammonia pumps. For durability and minimum of friction, it is unexcelled. Send for pamphlet. Address, Balance Valve and Piston Packing Co., room 58, 280 Broadway, New York.

Patent Binders for the AMERICAN MACHINIST, holding a complete volume (52 issues), simple, neat, durable. Price, $1, prepaid, to any part of the United States by mail. To Canada or foreign countries the price will be 75c.; purchasers pay express charges and customs duties. AM. MACHINIST PUB'G CO., 96 Fulton st., N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2 post-paid. Published by John Wiley & Sons, 15 Astor Place, New York.

Manufactures.

M. J. Gibbs, North Findlay, N. Y., will erect a large plow factory.

Two furnaces, pipe works and steel works are projected at Selma, Ala.

The Sumter Cotton Mills, S. C., will purchase $10,000 of new machinery.

A company is being formed at Beaver Falls, Pa., to build a large machine works.

Sohmer's piano factory, eight stories high, is nearly completed in Astoria, N. Y.

Friendship, N. Y., will soon have a factory for mowing machines. C. C. Deming is interested.

The Trainer Manufacturing Company, Trainer, Pa., will erect a large woolen mill in the spring.

A $100,000 company has been formed at Peoria, Ill., to build a large brewery at Little Rock, Ark.

It is stated that the Southern Locomotive Works has been organized to build works at Anniston, Ala.

A company will be incorporated at Montgomery, Ala., to build car works, by B. R. McKenzie and others.

Geo. B. Pelham will erect a four-story brick factory, 149x143 feet, at Thirteenth and Gansevoort streets, New York.

The Soque Woolen Mills, Soque, Ga., will double the capacity of their woolen mill, and erect a bobbin and shuttle mill.

The New Orleans and Gulf Railroad Company (office, New Orleans, La.) are removing their shops from Shell Beach to Poydras.

J. A. Fritter & Co., Baltimore, will erect a four-story brick factory, 50x130 feet, on Pratt street, between Green and Emory.

D. Eagan, of the Shenango Machine Company, has secured land on Sharon, Pa., for an open hearth Bessemer steel plant, employing 200 men.

There are no soap works in Servia. It would be a good move for some of our eccentric soap advertisers to start branch factories in Servia.

Beaman & Smith, Providence, R. I., lately started in business as makers of machine tools and special machinery, write us: "Things look bright."

Sam'l Bixby will erect four five-story brick factories, with boiler-house, on Elton avenue, corner 160th street, New York. The cost is to be $55,000.

H. F. De Bardeleben, Birmingham, Ala., and associates will erect a large rolling mill at Bessemer, twelve miles from Birmingham. About $500,000 will be invested.

The Edison Electric Light Company, of Dayton, O., will put in an additional plant, and have contracted with E. H. Brownell & Co., of that city, for three 72"x16 foot boilers.

H. L. Gordon & Son, of West Garland, Me., have been shipping their machinery to Caribou, where they will henceforth conduct the foundry and machine business.—*Industrial Journal.*

The Alabama Carriage and Wagon Company, Birmingham, Ala., has been incorporated by C. B. Powell, of Helena, Ark., C. B. Gordon, Racine, Wis., and J. A. Powell, Iuka, Miss. They will erect large works.

The Gordon & Maxwell Company, manufacturers of steam pumping machinery, Hamilton, O., write us: "We desire to state that we have just closed the largest year's business we ever did, and look forward to still more business for the year 1887."

H. Bickford, manufacturer of drill presses in Cincinnati, O., has sold out to the Bickford Tool and Machine Company, composed of Geo. A. Gray, Jr., Kierkhoff Bros. and Mr. Hoffinghoff. The new firm takes the works April 1, Mr. Bickford retiring.

O. E. Cope, for some time past a draftsman and erecting engineer in the employ of the Buckeye Engine Company, of Salem, Ohio, has gone to Carthage, Mo., to take an interest in and act as superintendent for the Carthage Foundry and Machine Shops.

The Birmingham Machine and Foundry Company—capital stock, $100,000—has been chartered at Birmingham, Ala., to manufacture machinery, tools, railroad supplies, etc., by R. D. Johnston, R. W. Boland, S. M. Evans, Geo. Ball and others.—*Baltimore Manufacturers' Record.*

Thatcher's calculating instrument is made by Keuffel & Esser, New York. They issue a circular with a cut and explanation, and a lot of testimonials from railroad officers, bridge works manufacturers, and others who have used them. It seems to be a great labor-saver, and is low in price.

The Montgomery Land and Improvement Company—capital stock, $750,000—has been formed at Montgomery, Ala., by W. L Chambers, F. M. Billings, H. C. Moses, C. A. Lamier and others. The object of the company is to start a town near Montgomery, and assist in establishing manufacturing enterprises.

The Putnam Machine Company, Fitchburg, Mass., have completed an addition of 70x150 feet to their foundry. The old foundry was 60x150 feet, and the addition is such as to make a letter T of the plant. The new as well as the old part of foundry is fitted with convenient crane appliances, and excellent facilities for doing all classes of work.

Pedrick & Ayer (L. B. Flanders Machine Works), of Philadelphia, have sent out a calendar tablet for 1887, which is something novel and useful. Every leaf, commercial note size, is ruled off for one week's memoranda. Prints of their several machines and tools in light blue appear on the pages. They make special tools for all purposes for railway repair shops. The firm write us: "Our railroad friends appreciate its usefulness very much, as some 500 letters and postal cards will certify."

The Brown & Sharpe Manufacturing Company, and Darling, Brown & Sharpe, Providence, R. I., have issued their catalogues and price lists of machinery, tools and castings in pocket form under date of January 1, 1887. The pamphlet has 155 pages, copiously illustrated with the tools and machinery made by both establishments. Some new articles are represented, among which we observe a large vertical spindle milling machine, with platen 36' long and 12" wide. It has automatic feed in either direction. Upwards of 400,000 Wilcox & Gibbs' sewing machines have been made at these works. They manufacture special machines to order, in addition to the regular machines and tools described in the catalogue, which are usually kept in stock. Their department of standard gears is becoming quite extensive, and agencies have been established in eight important cities. The last page of catalogue gives rates of postage (from two cents to twenty-four cents) on a large number of small tools that can readily be sent by mail. The catalogue will be sent upon application.

Machinists' Supplies and Iron.

NEW YORK, Jan. 27, 1887.

There is still the same tendency to increase prices of American pig iron, which we have noted from week to week recently. There is a strong feeling, not only that higher prices have come to stay, but that there will be still further advances.

The prices of finished machinery have not been advanced as a general thing, but manufacturers may be relied upon to get better prices soon.

American Pig—We quote best brands No. 1 X, $22 to $22.50; No. 2 X, $20 to $20.50; Grey Forge, $18.50 to $19.

Scotch Pig—Transactions are small, but prices are held fairly firm, at Coltness, $23.50 to $24; Gartsherrie, $22.50 to $23; Summerlee, $23.50; Eglinton, $21; Langloan, $21.50 to $23; Dalmellington, $21.50.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

First-class toolmaker wanted. B. W. Payne & Sons, Elmira, N. Y.

Energetic, successful supt. wishes engagement on heavy work; good references. L. L., AM. MACHINIST.

Wanted—By an experienced patternmaker, situation as foreman patternmaker; good reference. Address S. K., AM. MACHINIST.

Foreman Wanted—One used to building lathes: must be a practical machinist and able to handle 50 men to best advantage. Address Lathe, AM. MACH.

Wanted to Rent—A small machine shop located in Eastern or Middle States. Address Box 9, AM. MACHINIST.

Wanted — Mechanical draftsman. Address "Conly," office of AM. MACHINIST, stating amount and kind of experience had and compensation required.

Wanted—Position as foreman boilermaker by practical mechanic, who has been foreman a number of years; will give reference as to ability, etc. Address J. W. T., AM. MACHINIST.

A thoroughly competent mechanical engineer, experienced in drafting and constructing all kinds of engines, boilers, mill work, general machinery, etc., and in estimating costs, desires an engagement. W. B. Y., AM. MACHINIST.

Superintendent or Foreman—A first-class machinist and toolmaker, having held the above position for a number of years, desires a similar position; first-class references from late employes. Address F., AM. MACHINIST.

Middle-aged mechanical engineer, with a thorough, practical education, wants situation as superintendent or head draftsman with concern making machinery for gas works, or making printing press preferred. Address Box 8, AM. MACHINIST.

Young man with general knowledge of machine and foundry business—understands drawings thoroughly—desires a position as salesman or solicitor of castings and contract work; near New York city preferred. Address E. B., AM. MACHINIST.

M. E. and draftsman, now engaged in literary work, who previously worked in succession as machinist, draftsman and designer, wants steady position in the latter capacity again, preferably with concern making machine tools, in N. Y. or vicinity. Address "Theory and Practice," AM. MACHINIST.

Wanted—A young man thoroughly competent to act as foreman of machine department in a shop manufacturing steam engines and improved saw mill machinery; must understand managing men, and be well posted in improved methods of doing work; good character and habits essential; would have charge of 25 or 50 men; state age, experience, and where formerly employed. W. X., AM. MACH.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

The Cyclone Steam Flue Cleaner has no equal, Crescent Mfg. Co., Cleveland, Ohio.

Crescent Boiler Compound has been used 40 years and still the best. Crescent Mfg. Co., Cleveland, Ohio.

Light mach'y of all kinds built at short notice Edmund Mills, 8 Dey st., Jersey City Heights, N. J.

For Sale—One 1⅛" Merriman bolt-cutter, one 20' swing, 12 ft. bed, engine lathe, both new. The McLagon Foundry Co., New Haven, Ct.

Take Notice—An inventor wants a partner, or will sell some very valuable ideas. Address J. H. F., Box 7, Merchantville, Camden Co., N. J.

Wanted—Several first-class machinists for general job work; steady employment for the right kind of men. Address T. E. Krauss, Columbus, O.

Wanted—Self-acting machines for adjusting and clipping of iron wire in rings on bars. Address offers, with photographs, to R. M., 500, care of Haasenstein & Vogler, Frankfort-on-Main, Germany.

An industrious, first-class mechanic, fully competent to manage a manufacturing business, who would want to engage in steam-engine or any other manufacturing, could find a good opportunity to have an interest in a long and well-established manufactory, located in a lively city, with good railroad facilities, on the upper Mississippi river; good reference required. Address Manufacturer, AM. MACHINIST.

For Sale — Valuable Manufacturing Property, centrally located in one of the largest Western States, with a well-established reputation for the goods of its manufacture, which consist of engines, boilers, saw and grist mill machinery, and kindred articles. Property all in first-class condition; tools and machinery in good order, and the works now running. Parties who mean business, and desire to engage in a profitable and well-established business of this character, can get full particulars by writing or applying in person to M. D. Wheeler, Stapleton, Staten Island, N. Y., or Manning, Maxwell & Moore, 111 and 113 Liberty st., New York.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 15 cents per line, each insertion.

Experimental and new machinery for special purposes built by contract from specifications and inventors' designs; ample facilities. Cohoes Iron Foundry and Machine Co., Cohoes, N. Y.

Special tools and machines for mfg. designed and built to order; mechanical and Patent Office drawings. Weston & Smith, Syracuse, N. Y.

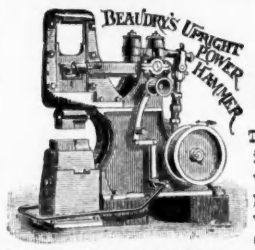
BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Established 1882.

Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the **World.**

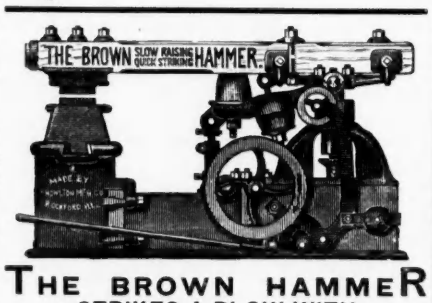
BRADLEY & CO. Syracuse, N.Y.

BEAUDRY'S UPRIGHT CUSHIONED POWER HAMMER



The success of our machine is the best guarantee of its value. Only hammer with patent Duplex Steel Helve which never rattles, burns or breaks. Guaranteed to do more and better work with less repairs than any other.

BEAUDRY & CUNNINGHAM, Boston, Mass.



THE BROWN HAMMER

STRIKES A BLOW WITH

Double the Velocity That it Raises the Hammer.

A NEW MOVEMENT! SEND FOR DESCRIPTION.

KNOWLTON MFG. CO., KING ST., ROCKFORD, ILL.

STEPHENS PATENT VISES.

ONE-HALF TIME and LABOR saved by using this solid, strong, durable, firm-hold, quick-working Lever (Not Screw) Vise. Has improved Taper-Pipe and other attachments. Sold by the trade. Send for circular

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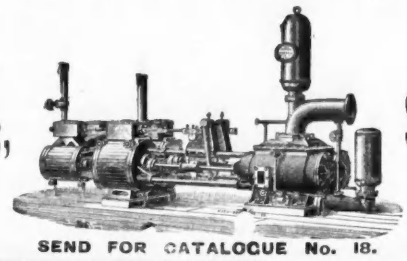

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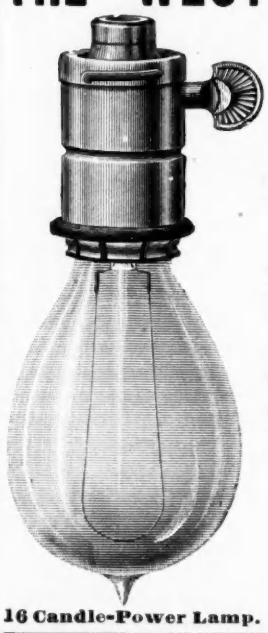

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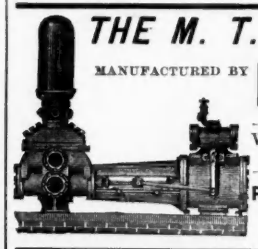

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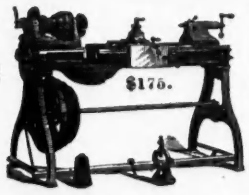

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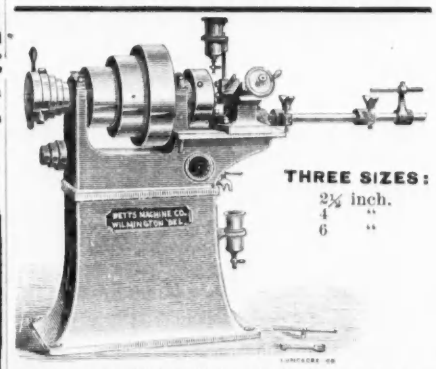

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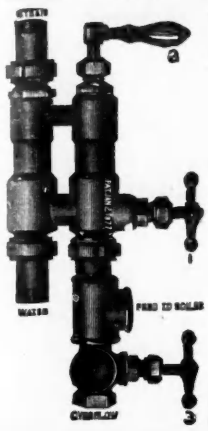

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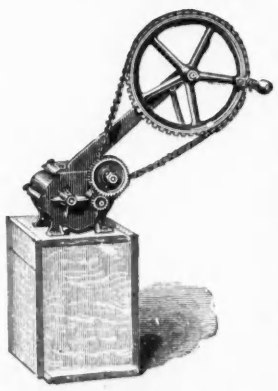

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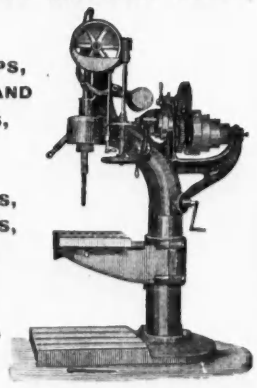

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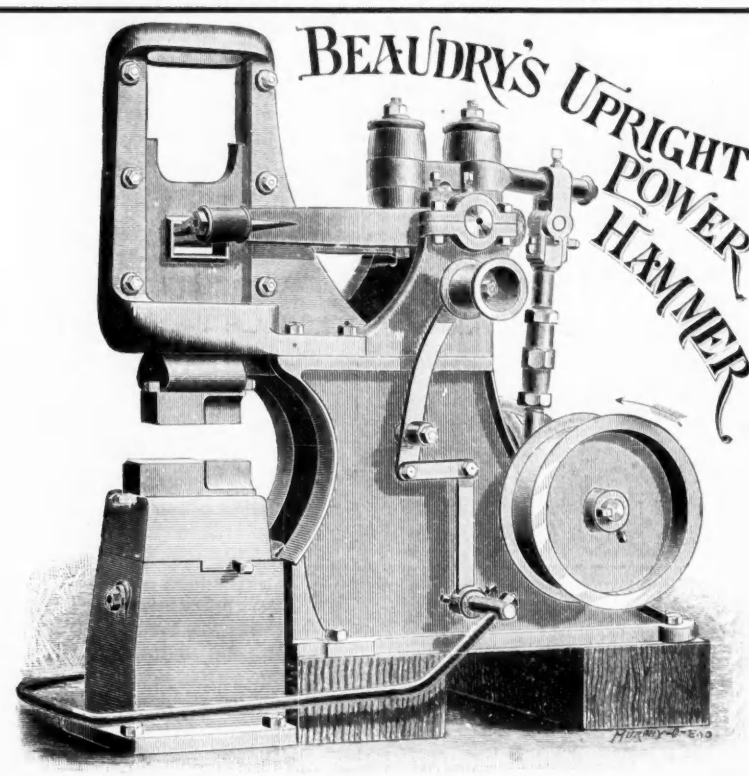

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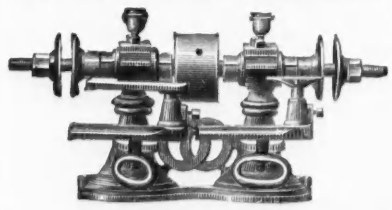

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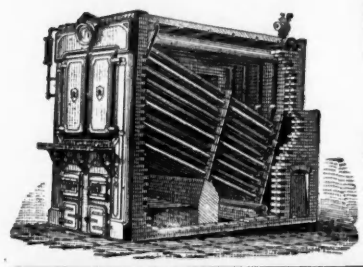

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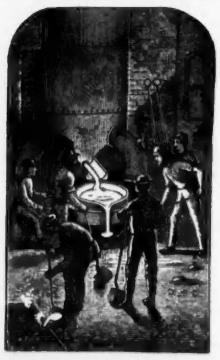

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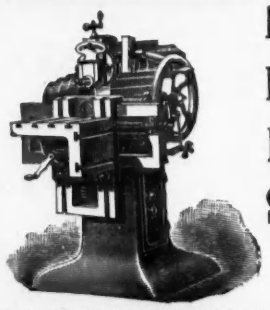

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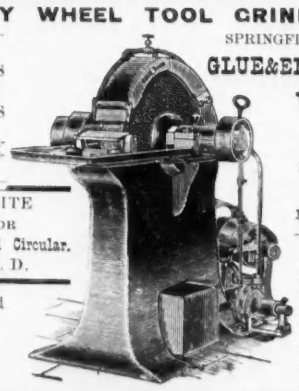

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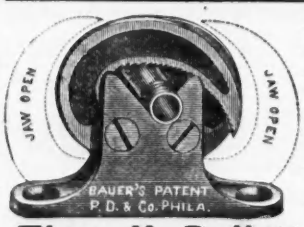

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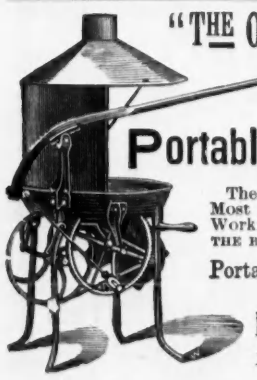

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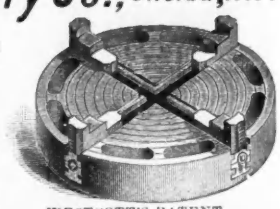

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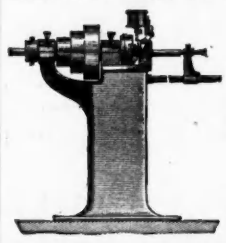

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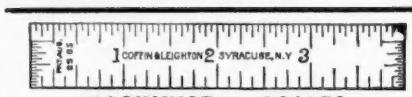

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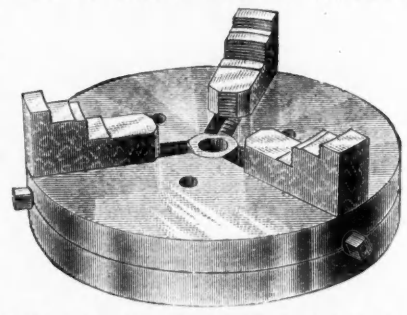

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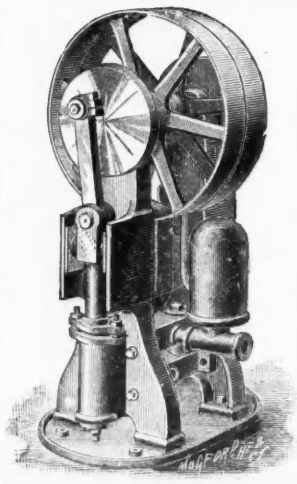

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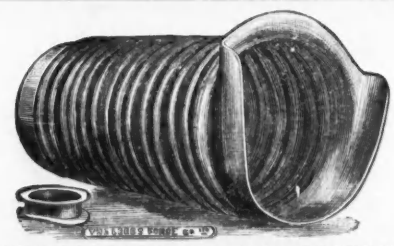

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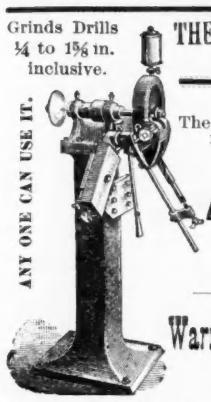

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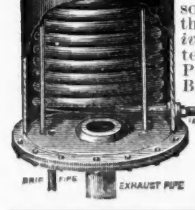

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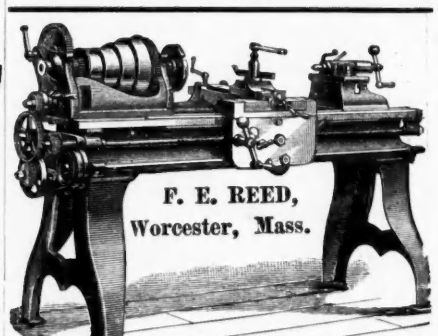

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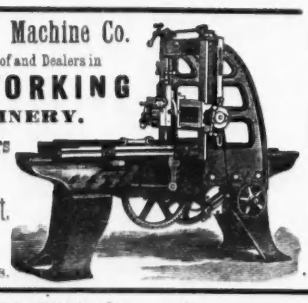

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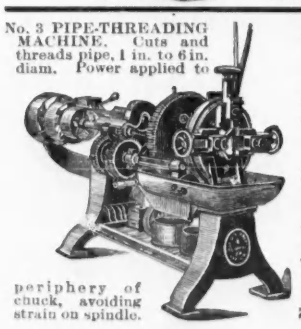

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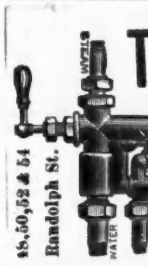

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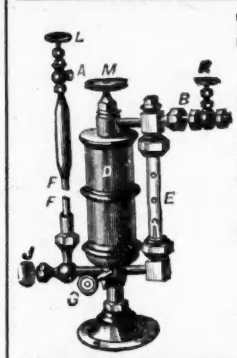

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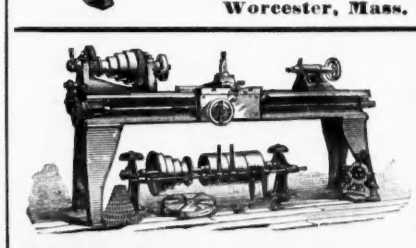

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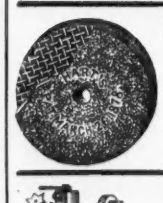

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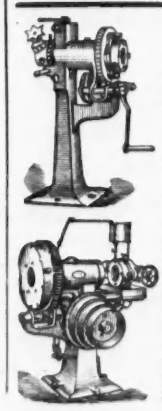

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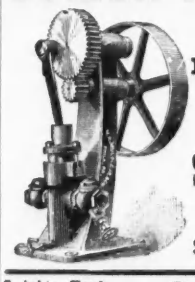

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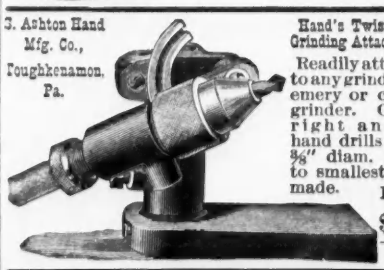

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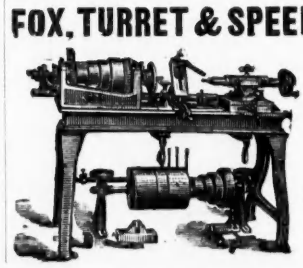

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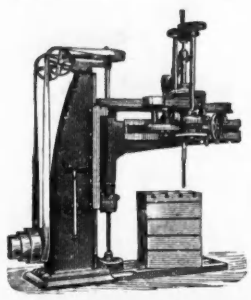

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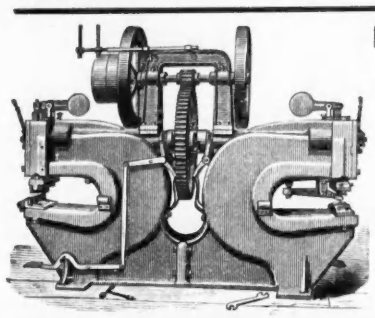

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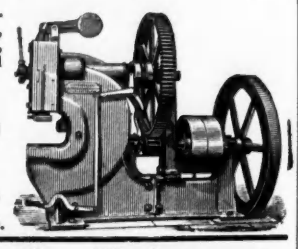

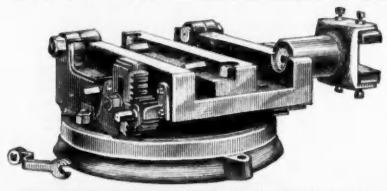

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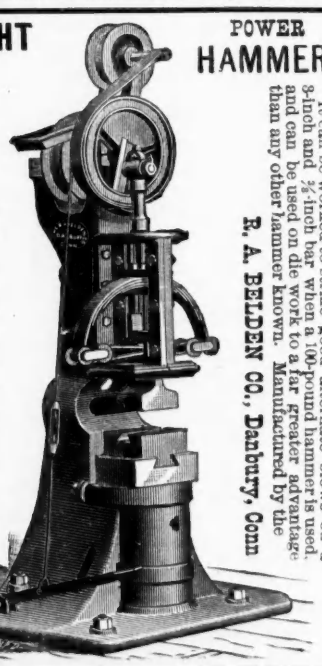

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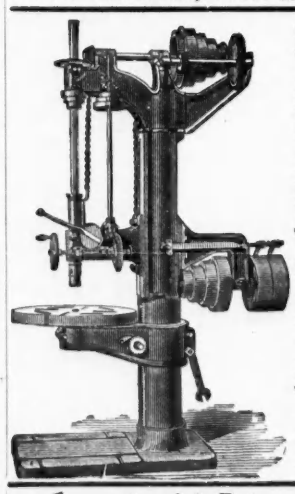

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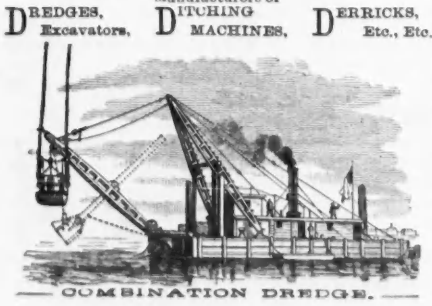

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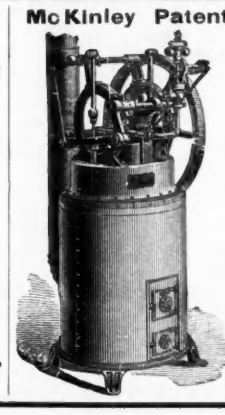

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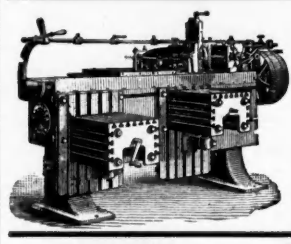

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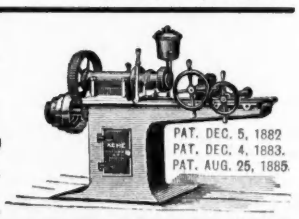

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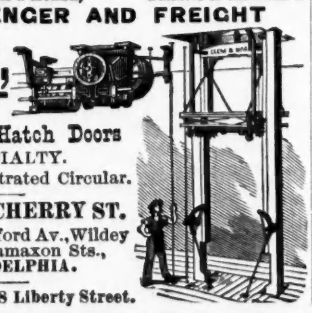

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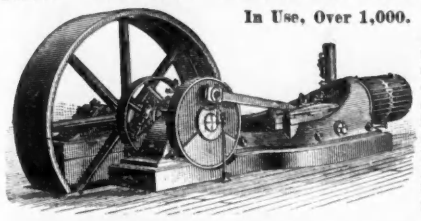

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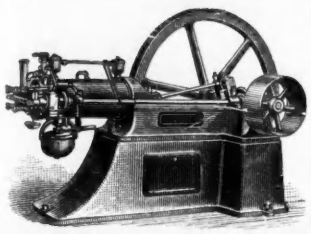

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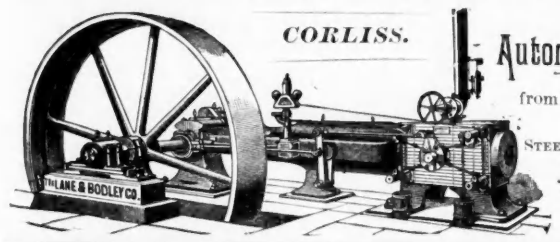

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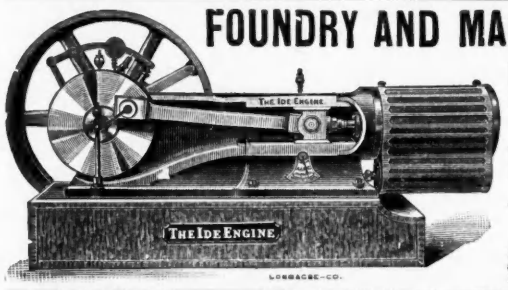

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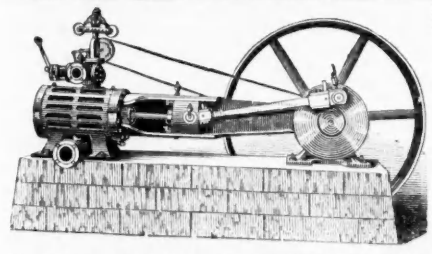

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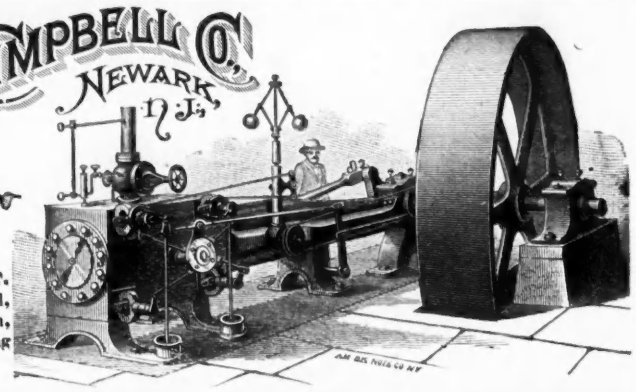

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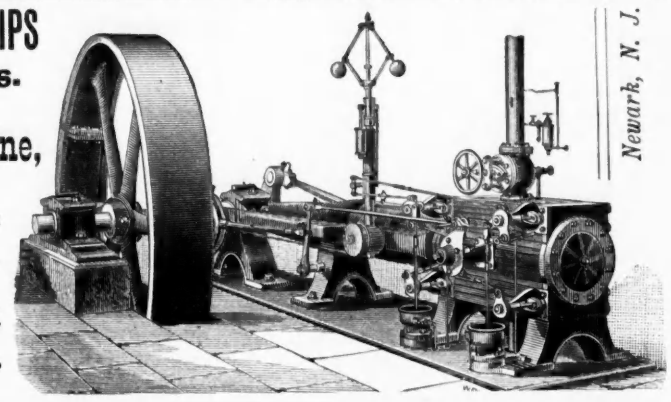

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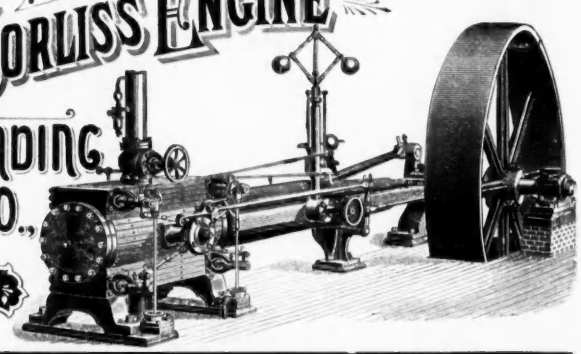

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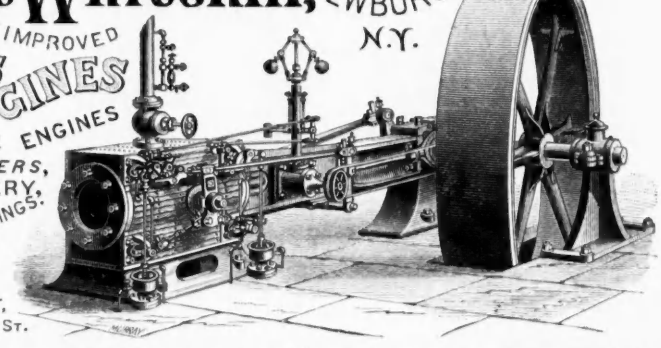

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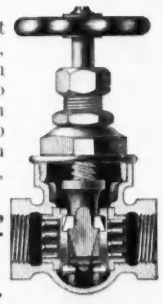

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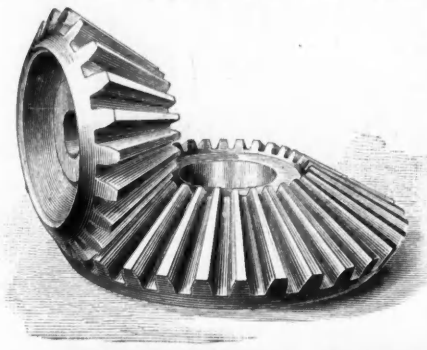

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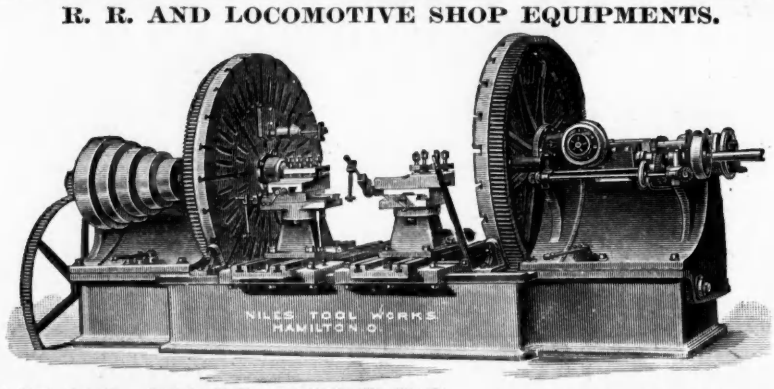

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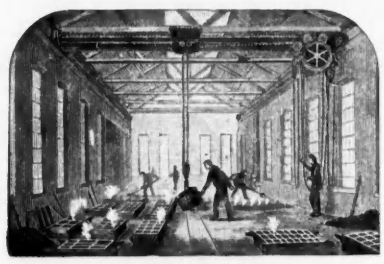

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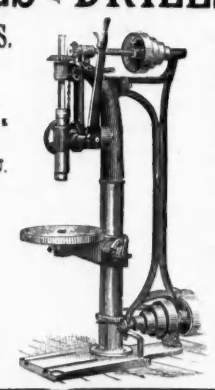

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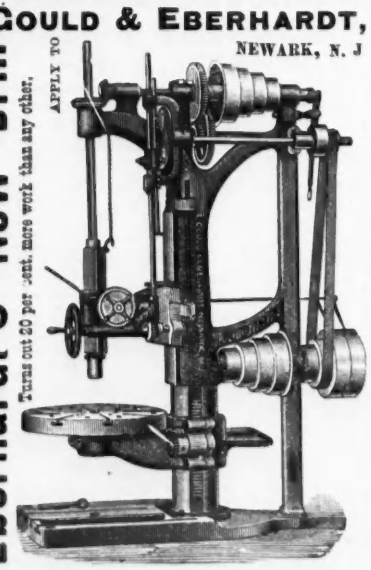

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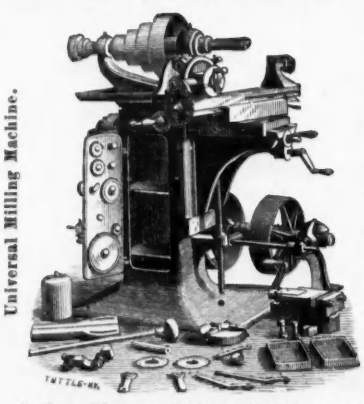

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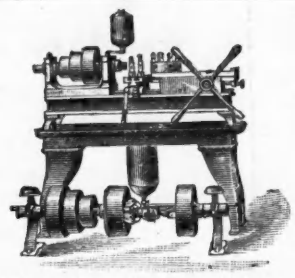

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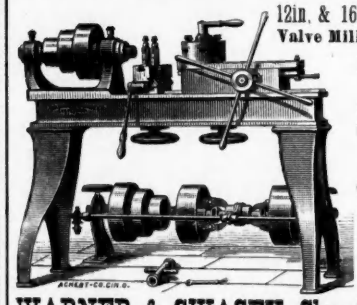

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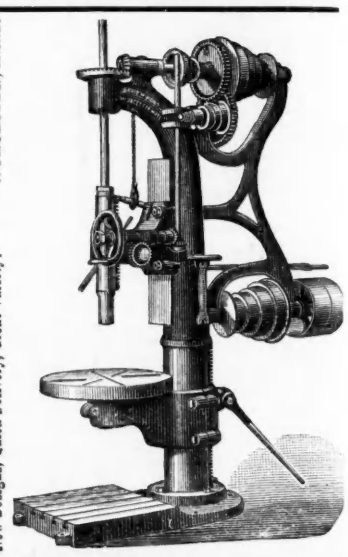

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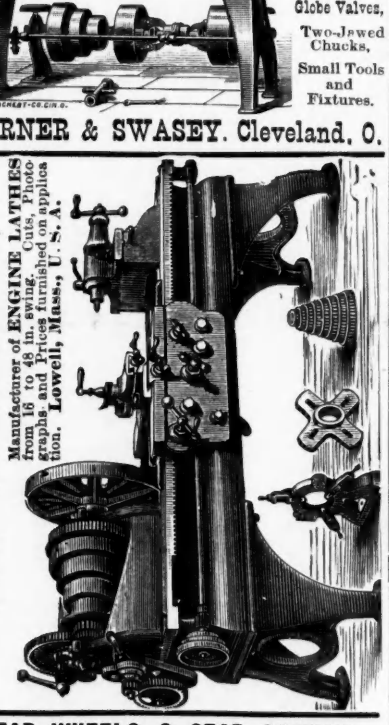

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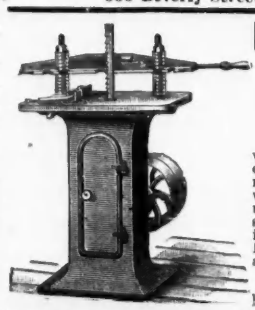

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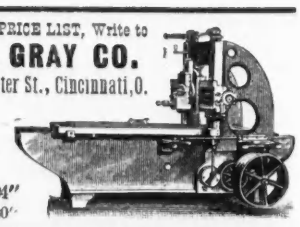

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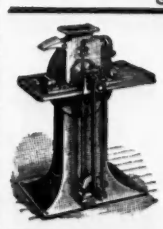

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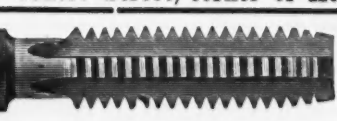

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